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Preliminary Data Summary for the Used Oil Reclamation and Re-Refining Industry

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This document is one of a series of Preliminary Data Summaries prepared by the Office of Water Regulations and Standards of the U. S. Environmental Protection Agency. The Summaries contain engineering, economic and environmental data that pertain to whether industrial facilities in various industries discharge pollutants in their wastewaters and whether the EPA should pursue regulations to control such discharges. The summaries were prepared in order to allow EPA to respond to the mandate of Section 304(m) of the Clean Water Act, which requires the Agency to develop plans to regulate industrial categories that contribute to pollution of the Nation's surface waters. Summaries for categories already subject to rulemaking were developed for comparison purposes, and contain only the minimum amount of data needed to provide some perspective on the relative magnitude of the pollution problems created across the categories.

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PRELIMINARY DATA SUMMARY
FOR THE
USED OIL RECLAMATION
AND RE-REFINING
INDUSTRY

Office of Water Regulations and Standards
Office of Water
United States Environmental Protection Agency
Washington, D.C.

September 1989

PREFACE

This is one of a series of Preliminary Data Summaries prepared by the Office of Water Regulations and Standards of the U.S. Environmental Protection Agency. The Summaries contain engineering, economic and environmental data that pertain to question as to whether the industrial facilities in various industries discharge pollutants in their wastewaters and whether the EPA should pursue regulations to control such discharges. The summaries were prepared in order to allow EPA to respond to the mandate of section 304(m) of the Clean Water Act, which requires the Agency to develop plans to regulate industrial categories that contribute to pollution of the Nation's surface waters.

The Summaries vary in terms of the amount and nature of the data presented. This variation reflects several factors, including the overall size of the category (number of dischargers), the amount of sampling and analytical work performed by EPA in developing the Summary, the amount of relevant secondary data that exists for the various categories, whether the industry had been the subject of previous studies (by EPA or other parties), and whether or not the Agency was already committed to a regulation for the industry. With respect to the last factor, the pattern is for categories that are already the subject of regulatory activity (e.g., Pesticides, Pulp and Paper) to have relatively short Summaries. This is because the Summaries are intended primarily to assist EPA management in designating industry categories for rulemaking. Summaries for categories already subject to rulemaking were developed for comparison purposes, and contain only the minimal amount of data needed to provide some perspective on the relative magnitude of the pollution problems created across the categories.

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) regulates or makes determinations as to whether to regulate certain industrial categories under several major environmental statutes. These statutes include the Clean Water Act, the Resource Conservation and Recovery Act, and the Clean Air Act. This report is part of the process by which EPA is considering what management standards may be appropriate for the recycling of used oil, in response to the requirements mandated by these Acts.

The study has attempted to characterize and profile the Oil Reclaimer/Re-Refining Industry. The distinction between the reclaimers and re-refiners is the degree of sophistication in processing the used oil, and the resultant end product; reclaimers use simplistic processing, re-refiners' end product is of base lube stock quality.

The goals of this preliminary effort were to: conduct a literature review, perform an industry profile, site visit re-refiners, screen sample re-refiners, and develop a Preliminary Data Summary. These goals have been realized through the work conducted during 1986 and 1987.

A total of sixty-eight facilities have been tentatively identified as being either reclaimers or re-refiners. Seven candidate re-refineries for screen sampling were visited and four were sampled, as part of initial plans to characterize wastes within the industry. Preliminary results indicate a wide range of pollutants present in both the liquid and solid streams sampled. Screen sampling data results have been included herein.

The Agency is presently interpreting and evaluating the analytical data collected during the re-refinery screen sampling program. Findings will be contained in future reports that will be available for public review.

Chapter 1

INTRODUCTION

This document details various information that has been gathered concerning the Used Oil Reclaimer/Re-Refining Industry by the Industrial Technology Division (ITD) of the U.S. Environmental Protection Agency's Office of Water Regulations and Standards. The document will be used by the Agency in its decision-making processes to determine whether national effluent limitations guidelines or a different regulatory approach are warranted for this industry and to characterize liquid and solid wastes from industry processes.

The study has attempted to identify and profile the industry, identify the types and sources of waste streams that are being generated, and collect data to characterize the quality of such streams.

1.1 Project Objectives

The objectives of this Project were to profile the industry, identify the types and sources of waste streams that are being generated by facilities within the industry, collect data to characterize the quality and quantity of such streams, and suggest future actions regarding regulation and/or guidance development.

These objectives have been partially met by collecting varying levels of data through industry sources and the literature, and by collecting and analyzing screen samples of liquid and solid wastes.

1.2 Overview

The oil reclaimer/re-refining industry is defined by the Bureau of the Census Standard Industrial Classification (SIC) 2992. The raw material of this industry is used oil. As defined by the 1986 Annual Book of ASTM Standards, used oil is oil whose characteristics have changed since being originally manufactured and which is suitable for recycling (processing oil that has become unsuitable for its intended use in order to regain useful material).

Consistent with earlier Agency review and investigation, two distinct used oil recycling entities exist within the used oil management system: (1) Reclaiming, wherein relatively simple cleaning methods (settling, heating, dehydration, filtration and centrifugation) are used during the recycling process primarily to remove insoluble contaminants and thus making the oil suitable for some sort of further use; and (2) Re-refining, where refining processes during recycling are used in order to produce high quality base stock for lubricants or other petroleum products. Re-refining may include distillation, hydrotreating, and/or treatments employing acid, caustic, solvent, clay and/or chemicals.

Previous studies conducted by the Agency regarding "Used Oil as a Hazardous Waste" indicate a wide range of contaminants to be present in the used oil base stock. It was therefore logical to suspect that the recycling of used oil via either simple physical cleaning methods or by more sophisticated refining (chemical) processes would yield as by-products of that process broad ranges and quantities of contaminants.

1.3 Regulatory Background

Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." By July 1, 1977, existing industrial dischargers were required to achieve "effluent limitations requiring the application of the best practicable control technology currently available" (BPCTCA), as specified in Section 301(b)(1)(A). By July 1, 1983, these dischargers were required to achieve "effluent limitations requiring the application of the best available technology economically achievable (BAT), which will result in reasonable further progress toward the national goal of eliminating the discharge of pollutants," as specified in Section 301(b)(2)(A). New industrial direct dischargers were required to comply with new source performance standards (NSPS), as specified in Section 306, based on best available demonstrated technology. New and existing dischargers to publicly owned treatment works (POTW) were subject to pretreatment standards under Sections 307(b) and Section 307(c). While the requirements for direct dischargers were to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the Act, pretreatment standards were made enforceable directly against dischargers to POTW (indirect dischargers).

Although Section 402(a)(1) of the 1972 Act authorized the setting of requirements for direct dischargers on a case-by-case basis in the absence of regulations, Congress intended that, for the most part, control requirements would be based on regulations promulgated by the Administrator of EPA. Section 304(b) of the Act required the

Administrator to promulgate regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of BPT and BAT. Moreover, Sections 304(c) and 306 of the Act required promulgation of New Source Performance Standards (NSPS). Sections 304(f), 307(b), and 307(c) required promulgation of regulations for pretreatment standards. In addition to these regulations for designated industry categories, Section 307(a) of the Act required the Administrator to promulgate effluent standards applicable to all dischargers of toxic pollutants. Finally, Section 501(a) of the Act authorized the Administrator to prescribe any additional regulations "necessary to carry out his functions" under the Act.

On December 27, 1977, the President signed into law the Clean Water Act of 1977. Although this law makes several important changes in the Federal water pollution control program, its most significant feature is its incorporation into the Act a program for toxic pollution control. Section 301(b)(2)(A) and Section 301(b)(2)(C) of the Act required the achievement by July 1, 1984, of effluent limitations requiring application of BAT for "toxic" pollutants, including the 65 "priority" pollutants and classes of pollutants which Congress declared "toxic" under Section 307(a) of the Act. Likewise, EPA's programs for New Source Performance Standards and pretreatment standards are now aimed principally at toxic pollutant controls. Moreover, to strengthen the toxics control program, Congress added Section 304(e) to the Act. Section 304(e) authorizes the Administrator to prescribe what have been termed "best management practices" (BMP) to prevent the release of toxic pollutants from plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage associated with, or ancillary to, the manufacturing or treatment process.

The Clean Water Act of 1977 also revised the control program for nontoxic pollutants. Section 301(b)(2)(E) now requires achievement by July 1, 1984 of "effluent limitations requiring the application of the best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those mentioned specifically in Section 304(a)(4), (biochemical oxygen-demanding pollutants (BOD_5), total suspended solids (TSS), fecal coliform, and pH), plus any additional pollutants defined by the Administrator as "conventional." On July 30, 1979, the Agency designated oil and grease as a conventional pollutant (44 FR 44501). The BCT requirements are developed based upon a two-part cost test. The first cost test compares the cost per pound of conventional pollutants removed for the BCT requirements to the cost that a POTW incurs for removing similar pollutants. The second cost test compares the cost of the BCT requirements with the costs to attain BPT for the industry category being evaluated.

For nontoxic, nonconventional pollutants, Sections 301(b)(2)(A) and (F) of the 1977 amendments required achievement of BAT effluent limitations within three years after their establishment or July 1, 1984, whichever is later, but not later than July 1, 1987. In February 1987, the Water Quality Act of 1987 revised this date to March 31, 1989.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) establishes a comprehensive scheme regulating the management of solid wastes. Some solid wastes are classified as hazardous under RCRA Subtitle C and are therefore subject to more stringent requirements than other solid wastes, i.e., regulations governing generation, transportation, treatment, storage, and disposal.

However, the 1980 amendments to RCRA excluded several types of solid wastes from regulation as hazardous wastes until EPA has submitted certain studies to Congress and made certain regulatory determinations [Solid Waste Disposal Act Amendments of 1980, Pub. L. No. 94-482, Section 29, 94 Stat. 2349].

Pursuant to Section 3001(a) and Section 3001(b) of the RCRA regulations, solid wastes can be classified as hazardous in two ways. First, EPA can determine that a particular type or category of solid wastes is hazardous and should be included on a list of categorically hazardous wastes [40 CFR Section 261.11, 261.30-261.33 (1984)]; the lists under 261.33 were updated in 1986 [52 FR 28296]. Second, if a solid waste exhibits one of four characteristics (ignitability, corrosivity, reactivity, or extraction-procedure toxicity), it is considered hazardous [40 CFR Section 261.10, 261.20 to 261.24 (1984)].

Section 3012 of RCRA, added to the statute by the Used Oil Recycling Act of 1980 and amended (and re-designated as Section 3014) by the 1984 RCRA amendments, directs the Administrator to "promulgate regulations . . . as may be necessary to protect human health and the environment from hazards associated with recycled oil.

The Agency has previously determined that used oil being recycled should not be listed as a hazardous waste under RCRA. EPA intends, however, to issue recycled oil management standards. This project is part of the process by which EPA is considering what management standards are necessary for recycled oil. It is believed that improper recycling of used oil can pose substantial environmental hazards. The evaluation of residues, waste waters, and sludges associated with the recycling of used oil is essential. The Agency may list one or more waste streams as hazardous even if used oil itself is not listed.

Chapter 2

BACKGROUND REVIEW

2.1 Review Process

An integral aspect in the Data Summary process included the review of the oil reclamation and re-refining industry literature. The review identified available information that focused on oil reclamation and re-refining process operations, by-products, waste management techniques, and current state and federal regulations governing the disposition of wastewater and solid wastes for this industry.

This section presents the methods by which the literature review effort was performed, the major subject areas covered by the literature review, and the indexing and sorting system used for tracking and maintaining reference materials.

Section 2.2 identifies the various sources that were searched in order to obtain reference materials. Section 2.3 presents the five subject areas that were used to catalog the material. References are categorized according to topic; some references contain information pertaining to more than one subject.

2.2 Reference Sources

The reference materials in the literature review were obtained from a number of sources including previous EPA studies and reports, Department of Energy (DOE) investigations, OSHA database reviews, etc. From project inception, direction was given to use as much existing Agency material as possible. The project team was made aware of the potential for existing documents within other offices of the Agency. As such, the first source of information was previous reports prepared for the Office of Solid Waste (OSW) at EPA, pertaining to the topic of used oil. Within these documents, in some instances, additional references were obtained.

The second major source of information was the U.S. Department of Energy's Bartlesville Energy Technology Center (BETC) and the National Institute for Petroleum and Energy Research (NIPER) in Bartlesville, Oklahoma. For the last fifteen years, scientists at BETC and NIPER have been performing basic and applied research related to used oil and reclamation. This research has covered the broad spectrum from determination of specific compounds of interest to the development of patented innovative recycling processes. For the past ten years, Dr. Dennis W. Brinkman has been one of the leading figures within these organizations dealing with the used oil issue. Discussions with Dr. Brinkman and his colleagues resulted in obtaining valuable information for this project.

Other sources of information were computer literature searches. These searches included the following computer databases:

- Enviroline, a database that covers the world's environmental information.
- Pollution Abstracts, a database containing environmentally related literature on pollution, its sources, and its control.
- Occupational Safety and Health (NIOSH), a database covering all aspects of occupational safety and health, and includes such topics as hazardous agents, unsafe workplace environment, and toxicology.
- NTIS, a database consisting of government sponsored research, development, and engineering plus analyses prepared by federal agencies, their contractors, or grantees.
- Oceanic Abstracts, a database that organizes and indexes technical literature published worldwide on oceanography, marine biology, marine pollution, ships and shipping, geology and geophysics, meteorology, and government and legal aspects of marine resources.
- BEI Engineering Meetings, a database that indexes significant published proceedings of engineering and technical conferences, symposia, meetings and colloquia.
- Additional references were obtained from indices that appear in industry journals. These include Chemical Engineering, Hydrocarbon Processing, Industrial Wastes, Oil and Gas Journal, Chemical Engineering Progress, and Pollution Engineering.

2.3 Topics Reviewed

The following subsections provide brief summaries of the five literature review subject topics. Table 2.1 provides a matrix of the present literature review references and the topical subjects they address. The record numbers correspond to the references' location within the project files. Appendix A provides a cross-reference list of the references and their corresponding record numbers.

Industry Profile

This topic contains reference material that discusses different aspects of the oil reclamation and re-refinery industry. Material is included that discusses the size of the industry, the number and size of the existing facilities, and the current trends on the growth of the industry. Other subtopics include effects on the industry resulting from economic, technical and institutional constraints.

Because of the limited number of re-refineries, and because to some degree they have been regulated, referenced studies and reports readily exist on the re-refinery segment of the used oil industry. For the most part, the other segments (collectors, major/minor processors) in the used oil industry are not required to report their collection procedures or reuse practices. Thus, much of the collection, processing, and reuse of used oils in this country is not documented and thus there is very little existing information to draw from for these segments of the industry.

Description of Processes

This topic includes all reference material that discuss the different chemical and physical processes used in the oil reclamation and re-refining industry. Basically, there are four types of organizations involved in the used oil reclamation and re-refining industry: (1) independent collectors, (2) minor processors, (3) major processors; and (4) re-refiners. Independent collectors do virtually no processing of the oil they collect prior to its resale. Approximately 60 percent of the oil is sold to the processors and re-refiners.

Minor and major processors use in-line filtering and gravity settling with or without heat addition. As a further distinction, the major processors use other treatment devices to increase oil quality. The additional equipment includes distillation towers, large filter screens, centrifuges, agitators and blending devices.

Unlike the processor technologies, re-refining operations differ considerably and are much more complex. The major distinct types of re-refining technologies are: (1) solvent treatment/distillation/ hydrotreating; (2) acid/clay treatment, (3) vacuum distillation/clay polishing, and (4) chemical treatment/clay polishing.

Waste Stream Characterization

This topic includes all reference material that discusses the possible waste streams produced in the oil reclamation and re-refining industry. Reference material was included that discusses the solid and liquid by-products, the quantity and quality of these streams and the identity of these streams.

The liquid waste, in all instances, is a settled or unsettled wastewater. This waste stream is discharged either directly to surface waters or, more often, to a local POTW.

The solid wastes are much more varied in type and volume, depending on the facility processing technologies. Solid wastes consist of:

- in-line filter residues
- oily sludges
- tank bottoms
- centrifuge solids
- distillation bottoms
- spent and acid clay
- dissolved air or gas flotation (DAF) sludges

Control and Treatment Technologies

Reference materials identified under this topic discuss technologies available for the control and treatment of waste streams generated within the oil reclamation/ re-refining industry.

Typical treatment and control practices for the liquid waste streams include chemical injection of acid alum or caustic soda; equalization; API separation; flocculation using either caustic or polymers; and air or gas flotation. In most instances the end-of-pipe effluent is discharged to the local sanitary sewer system.

Typical treatment and control for the solid wastes involves cleaning, dewatering and storage prior to transport to contract waste haulers or landfills.

Current Regulatory Requirements

Under the Resource Conservation and Recovery Act (RCRA), EPA issued regulations that may ultimately affect waste oils. To date, a minority of individual states have designated waste oils as either toxic or hazardous and have implemented special handling procedures. References dealing with various aspects of the regulatory environment concerning waste oil have been compiled.

The Used Oil Recycling Act of 1980 amended RCRA to encourage the use of recycled oil. The bill provided that labeling requirements be based on performance characteristics, not upon the origin of the oil. EPA was directed to evaluate whether to classify waste oil as a toxic waste under RCRA and to perform an economic impact analysis when developing reuse standards for oil.

The basis for listing waste oil as a hazardous waste rests on such concerns as the presence of PCB's and other toxic wastes in the oil, the possibility that the oil will enter surface and groundwater, and the release of toxic metals when waste oil is burned.

Table 2.1: Reference/Subject Matrix

RECORD NO.	INDUSTRY PROFILE	DESCRIP. OF PROCESSES	WASTE STREAM CHARACT.	CONTROL & TREAT TECH	COST & ENERGY ISSUES	CURRENT REGUL. REQ.
1				X		
2	X				X	
3		X				
4		X				
5	X	X	X	X		
6		X		X		
7		X			X	
8		X			X	
9					X	
10	X		X	X		
11	X	X	X		X	X
12		X	X	X	X	
13		X				X
14			X			
15		X			X	
16		X				
17	X	X	X	X		
18		X			X	
19		X		X	X	
20		X			X	

TABLE 2.1 (cont'd)

REFERENCE/SUBJECT MATRIX

RECORD NO.	INDUSTRY PROFILE	DESCRIP. OF PROCESSES	WASTE STREAM CHARACT.	CONTROL & TREAT TECH	COST & ENERGY ISSUES	CURRENT REGUL. REQ.
21	X	X	X	X	X	
22		X			X	
23		X			X	
24		X			X	
25		X		X	X	X
26	X	X	X		X	
27		X				
28		X			X	
29		X				X
30	X	X	X	X	X	X
31		X				
32	X	X			X	X
33		X			X	
34				X		
35		X				
36		X				
37			X		X	X
38		X		X		X
39	X	X	X	X	X	X
40			X	X		

TABLE 2.1 (cont'd)

REFERENCE/SUBJECT MATRIX

RECORD NO.	INDUSTRY PROFILE	DESCRIP. OF PROCESSES	WASTE STREAM CHARACT.	CONTROL & TREAT TECH	COST & ENERGY ISSUES	CURRENT REGUL. REQ.
41		X				
42		X	X	X	X	
43			X			
44					X	
45		X				
46		X		X	X	
47		X			X	
48		X				
49					X	X
50		X			X	
51		X				
52		X	X	X		
53	X	X	X	X	X	X
54						X
55		X	X		X	X
56		X	X			X
57			X	X		X
58		X				
59	X	X				
60		X				

Chapter 3

INDUSTRY DESCRIPTION

3.1 Overview of the Industry

Another major project task was the compilation of a comprehensive industry profile.

Earlier Agency studies, and more specifically work performed under contract to the Office of Solid Waste (OSW) regarding the proposed rules for making used oil a hazardous waste, indicated the existence of an unorganized used oil management system in this country. Figure 3.1 summarizes the flow of oil from generators within that system into the three basic types of companies within the management system.

Independent collectors collect an extimated 25% of the used oil passing from the generators. The majority of the used oil entering the system, 75%, is directly collected by companies involved in processing (reclaiming) or re-refining the oil. The independent collectors sell about 62% of the oil they collect to either the reclaimers or re-refiners. Therefore, 90% (605.2 million gallons in 1983) of the oil entering the management system is assumed to be processed to some degree. The studies further indicate that approximately two-thirds of the processed oil is handled by major processor (reclaimer) facilities; 20% by minor processor (reclaimer) facilities; and about 14% by re-refinery facilities.

Because more than 90% of the used oil entering the system ends up at either the processors (reclaimers) or re-refiners, and because it is within these two basic recycling types that processing waste streams would occur, it was decided that these entities should comprise the industry profile.

Facilities within the industry were classified under two distinct recycling categories; reclaimers (processors) and re-refiners. Detailed descriptions of the two and their differences are more fully explained in Section 3.3. In compiling the profile, an attempt was made to categorize specific information on each, including name, size, geographic location, processes, waste stream generation, permit status, etc., to name a few.

3.2 Industry Profile Sources

Various available sources were used in order to compile the Industry Profile. From the outset, information from previous reports prepared for the Office of Solid Waste (OSW) at EPA pertaining to used waste oil were used.

A second source for the listings was a state-by-state telephone survey of state permitting agency personnel, and/or designated state used oil authorities. Telephone communications with the cognizant persons were conducted using a simple question and answer approach. In accordance with the Section 3.3 definition of a re-refiner, the contacts were asked whether or not re-refiners existed within the state. The contacts were also asked whether their permit files indicated the existence of sources within the Standard Industrial Classification (SIC) number 2992. In several instances the contacts were able to provide lists of used oil re-refining facilities and processors that existed in the area.

The Duns Market Identifier System (DMI) was polled for those facilities within SIC 2992. In excess of 800 facilities fell within this listing. The list was further reduced by evaluating specific data elements within the listing, namely, manufacturing indicator and the DMI line of business identifier. It must be noted that in both the Duns and State contacts listings any facilities whose name included the "re-refining" or "processors" terms within the company name were initially considered to be categorized accordingly. The continuing task of verifying whether they were either "re-refiners" or "processors" within the project's definitions was an ongoing task.

Perhaps most useful were the lists of existing re-refiners within the Association of Petroleum Re-Refiners (APR), and the corresponding list of existing processors/reclaimers within the National Oil Recyclers Association (NORA). These lists were reportedly composed of only active members of these organizations. Their importance rests not only in their clearly identifying existing facilities, but also in the historical resource and industry contacts they provided.

Tables 3.1 and 3.2 present the lists of processors/ reclaimers and re-refiners, respectively. In an attempt to improve on the profile information that had been compiled, a second telephone survey was conducted. In many instances, company representatives were unwilling to discuss the types of details requested, and quite frequently refused to give any responses.

3.3 Industry Description

As indicated earlier, the study has relied on SIC Codes, ASTM Standards and previous Agency studies in order to define and characterize the Industry. Those facilities within the "Used Oil Management System" which generate a waste stream as a function of their processing used oil were to be included, i.e., reclaimers/processors and re-refiners. Reclaimers and processors for the most part use simple processing technology in order to return the used oil into the market place for some sort of further use. Within this category there are two subcategories, minor and major processors. Re-refiners, on the other hand, are distinguished by the fact that they: (1) use more sophisticated, complex processing technology, and (2) generate a high quality lube stock. The following sections further define and distinguish the characteristics of those facilities included within the Industry.

Minor Processors

Minor processors are members of the used oil management system who collect used oil from generators and used oil collection sites. Minor processors use the most simplistic of processing technology and, as indicated in Figure 3.1, handle approximately 3.3 times (284 million gallons) less oil than the major processors. They separate water and some solids from the oil using simple settling technology, i.e., physical methods.

Primarily, only in-line filtering and gravity settling with or without heat addition is used. Process equipment includes pumps, flexible hoses, storage tanks, rigid above or below ground pipe, and heating devices.

The general markets for minor processors' product oil are direct fuel sales, virgin fuel oil dealers, non-fuel industrial uses, road oiling, re-refiners, and major processors. The objective of a minor processor is to improve oil quality to some degree, making it an acceptable product for various markets. Quality improvement usually means the separation of unwanted materials from the oil, thus creating waste products. Figure 3.2 is a schematic block diagram of a minor processor system.

Major Processors

Major processors are members of the used oil management system who collect used oil from generators, who may buy used oil from independent collectors, and who process the oil to remove water and solid contaminants. Processing technologies differ and include various combinations of several available methods including screen filtration, heated settling, centrifugation, light fraction distillation, and blending. Processed oil is sold to fuel oil dealers, direct to burners, as road oil, and to other miscellaneous users.

A major processor is more sophisticated than a minor processor with respect to processing technology. In addition to the processing equipment used to carry out the minor processor's simple treatment steps (storage tanks, pumps, flexible hoses, rigid above or below ground metal pipe, and heating devices), a major processor uses other tertiary treatment devices to further increase oil quality or to blend or mix materials into the oil. Additional equipment which is used includes distillation towers, large filter screens, centrifuges, agitators, and blending devices. Figure 3.3 summarizes the major processor system, including waste generation and management.

Re-Refiners

Re-refiners are the most sophisticated members of the used oil management system with respect to processing technologies. These companies collect used oil from generators or buy used oil from independent collectors. The oil is processed to give a recycled lube oil capable of being reused for its original purpose. A light hydrocarbon fuel is produced as a co-product of each of the four or five basic re-refining technologies currently in operation in the United States.

Unlike the simplistic processor technologies, re-refining operations are much more complex. The major distinct types of re-refining technologies are as follows:

- solvent treatment/distillation/hydrotreating
- acid/clay treatment
- vacuum distillation/clay polishing
- chemical treatment/demetallization/clay polishing

Of all current re-refineries, most of them are based on the distillation process. A few still remain that are based on the acid/clay re-refining process. This process was the predominant process two decades ago. In the acid/clay re-refining process, dehydrated waste oil is cooled and mixed with 5% to 6% of concentrated sulfuric acid, which is mixed vigorously and then allowed to settle. The tarry acid sludge is drawn off the bottom of the settling units and disposed of. The separated oil is contacted with approximately one pound of clay per gallon of oil. The oil/clay slurry is then reheated to 500-600 degrees F for several hours to neutralize any excess acid and to reduce the color and odor of the oil. After the oil is filtered to remove the clay, it is subjected to vacuum distillation to separate it into its viscosity components. A problem with the acid/clay process and a reason for its decrease in use is the problem of disposing of acid sludges. As pollution control laws have become more strict, it has become more difficult and more costly to dispose of the hazardous acid sludges.

Most current re-refineries have switched to using the physical process of distillation to separate the lubricating oil from other material. As in the acid/clay process, a vacuum distillation step follows the distillation process to further separate the oil into the different components.

A final step that has been getting recent attention is hydrotreating. The distillate fraction from vacuum fractionation is mixed with hydrogen gas and hydrotreated over a catalyst bed to yield a final product.

3.4 Process Descriptions

3.4.1 Minor/Major Processor

As indicated in the previous section, minor and major processors use in-line filtering and gravity settling with or without heat addition. As a further distinction, the major processors use other treatment devices to increase oil quality. The additional equipment includes distillation towers, large filter screens, centrifuges, agitators, and blending devices.

Centrifugation

Centrifugation is sedimentation with mechanically enhanced gravitation. Large, commercially available centrifuges operate at 2,000-4,000 times gravity (G). Thus, separations that take hours in gravity devices are accomplished in seconds in a centrifuge. Centrifuges are available with a perforate bowl and used for granular or crystalline precipitates. For sludges, a solid bowl centrifuge must be used.

The most versatile solid bowl centrifuge is a decanter. Decanters have two rotating elements, the bowl and a helical screw that rotates in the same direction as the bowl but at a slightly slower speed. The feed is introduced through the central shaft and thence through ports into the bowl of the centrifuge where it is rapidly accelerated to the speed of the bowl to form a relatively thin layer against the wall of the bowl. The depth of the liquid layer is controlled by an adjustable weir over which the clarified liquid discharges. The solids or sludge is pushed to the opposite end by the screw conveyer. At this end of the centrifuge the bowl narrows; as the solids are moved down this portion of the bowl, termed the beach, they are removed from the liquid, dried and then discharged. Figure 3.4 shows a schematic of a vertical centrifuge commonly used.

Screen Filtration

Filtration is a process used to screen out large impurities found in used oil. This process is generally used before more complex processing takes place. Filtration utilizes a filter cake method for filtering the oil. Filtration is accomplished by conventional means (i.e., vertical leaf or plate and frame filters) with filter cake dump at time intervals that depend on specific size and plant design.

Settling

In order to size equipment for continuous gravity settling, two factors must be determined: the overflow or rise rate and the retention time necessary to concentrate the underflow to the desired consistency.

Typically, in continuous gravity settling, the particulate-bearing solution is introduced into the feedwell located in the center of a circular settling basin and flows toward the outer circumference with a more-or-less uniform horizontal velocity. The particles have downward velocity induced by gravity and will be removed if the settled velocity is such that the particles settle a given distance before they traverse the basin. The distance is governed by the settling characteristics of the particles and the upward rise rate and horizontal velocity of the liquid. The upflow of clarified liquid must be less than the downward velocity of the settling particles to permit liquid-solid separation.

Thus, the overflow rate or rise rate relates the settling velocity to the liquid flow rate and is used to determine the area required for clarification to be accomplished. As the particles settle close to the bottom of the clarifier, they begin to settle more slowly because of interaction between particles. Thus, extra time or tank volume may be required to reach the underflow concentration desired.

3.4.2 Simple Processors

Distillation

Distillation towers are used to evaporate light fuel fractions and water from the waste water.

3.4.3 Re-Refining

Solvent Treatment

Solvent treatment of used lube oil can be used in place of acid treatment. The purpose is to remove not only metals but complex organics found in the oil as well. This process is performed before distillation and after initial filtering and is more effective than acid removal because of organic extraction.

The lube oil enters the solvent extraction vessel, mixes with the solvent, which is a mixture, and then separates into two phases, oil and solvent. While the oil and solvent are mixing, the metals and polar organics will dissolve in the solvent phase, thus leaving the oil phase. The oil phase then goes on to distillation or further extraction, while the solvent phase is treated or disposed of.

The organic material that can dissolve in the solvent are halogens that are polar and can readily dissolve in the alcohols and ketones that are in the solvent. A strong acid might not dissolve this type of organic material due to weak ionization potential as opposed to a heavy metal. However, any non-polar organics like benzene cannot dissolve in the solvent and will remain in the oil. Figure 3.5 illustrates a very basic diagram of a typical solvent treatment tank.

Acid/Clay Treatment

One method of re-refining used lube oil is acid/clay extraction. It is a simple method for removing impurities. The impurities are heavy metals and complex organics that come from the car engines and industrial boilers, as well as improper storage of the used oil. This is a physical process done continuously by the methods of extraction and adsorption.

The first step of the process is acid extraction. The used lube oil is contacted with concentrated sulfuric acid and then it separates into two phases: the lube oil phase, and the aqueous phase. Metals in the lube oil extract into the acid due to the solubility of the metals. The lube oil then goes on to the next step and the used acid gets disposed of.

In the clay adsorption phase, the oil passes through a clay bed adsorbing any left over metals, complex organics, and inert materials. After the oil passes through the bed, it goes on to vacuum distillation, or gets recycled through acid extraction. When the clay reaches maximum adsorption capacity, a solvent passes through the bed for regeneration. The solvent then gets disposed of. Figure 3.6 illustrates a typical acid/clay re-refining management system.

Distillation

Distillation can refer to simple heating of a liquid to vaporization and then condensation of the vapors, or it can be a complicated process using packed towers, steam, and vacuum to separate the liquid into fractions. Many petroleum purifying processes use distillation as a dehydration step. Most distillation processes include other steps, such as pretreatment with solvents, acid, caustic, clay, or hydrogen. Figure 3.7 illustrates a schematic of a 7 plate distillation tower.

Vacuum Distillation

Vacuum distillation is a very important process in oil re-refining. The purpose is to separate out of the used oil what is similar to the viscosity of lube oil. This process is essential after any type of treatment that removes contaminants of used oil, because of the importance of viscosity of lube oil.

The vacuum distillation column is operated at about 5mm Hg absolute. The reason for this is to prevent cracking and coking of the oil. The process then separates out the oil into different components depending on different viscosity ranges. After each distillate stream is set back to ambient conditions, the one that is most representative of lube oil is used. All the other streams do not have to go to waste and can be burned as fuel. The distilled oil could be further distilled into lower range viscosity components for better quality of oil.

Contaminants in the oil, especially organic halogens can cause a diversion in the viscosity and boiling point of the oil. If the oil were distilled with a halogen dissolved in the oil, the viscosity range of the lube oil could be greatly affected by the halogen resulting in little of the refined oil to be used. Therefore, solvent treatment to remove organic halogens must be used before distillation for more efficient results. Figure 3.8 illustrates a typical vacuum distillation re-refining management system.

Clay Polishing

The clay-polishing process generally requires higher temperatures and more clay than do virgin-derived lube stocks. This is attributed to traces of metals and oxygenates left after solvent precipitation and distillation. Typically, about 0.4 pound of an activated bleaching clay such as Filtrol 20 is used per gallon of oil, and the temperature is elevated to near 425 degrees F with steam sparge to produce an oil with a color of about 1-1/2 and a bland odor. Clay is removed by means of a filter press, and the oil is subsequently reformulated with appropriate additives for the designated service.

The process yields are typically 70 to 75 percent based upon the dry oil feedstock or near 90 percent on a oil-only basis. Since the sludges produced from both the solvent treatment and the distillation step are essentially neutral, they offer potential for use in roofing and road asphalt applications.

Clay-contacting is usually considered as a finishing step to other processes to decolorize the end product.

A comparison of hydrofinishing verses clay-contacting in the solvent-distillation process concluded that in the process cost for either finishing step was nearly the same. Clay-contacting requires less expensive equipment, less skilled labor, and more flexibility than hydrofinishing. However, clays do remove contaminants other than color bodies as can be seen by comparison of the clay-contacted oil with the distilled only fractions in a study of the solvent/distillation process. Acid number, base number, insolubles, sulfur, phosphorus, zinc, and sodium were all reduced by the clay treatment.

Hydrotreating

Hydrotreating has emerged as the technology of the future as the final step in waste-oil re-refining. There is little or no by-products which are organics. It is effective in reducing odor and color in the oil in order to make it marketable. Usually hydrotreating is used after distillation and the purpose is to remove any remaining contaminants which can later be burned.

The first step in hydrotreating is to react the oil with hydrogen. Then the oil temperature and pressure is increased, but not too much so cracking cannot occur. Afterwards, the oil is passed through a catalyst bed basically made of alumina. Here the hydrogen introduced earlier is released to a furnace, taking any contaminant with it. The products that evolve are a refined used oil, and gases which include hydrocarbons and water vapor. The hydrocarbons can be burned as fuel.

The major contaminants that hydrotreating takes out are non-polar organics, which have similar viscosity to lube oil. The alumina bed can absorb the complex organics while letting the lube oil pass through. This is because the complex organics have a larger molecular structure than that of the oil. Also, any metals can be absorbed in the alumina as well. After the contaminants are removed from the alumina, any remaining metals can be removed by solvent extraction, and the organics can be burned as fuel.

This process, even though it is relatively new, looks like the major step in re-refining. It is used only to improve the quality of the used oil for marketing purposes. Most hydrotreating processes come after vacuum distillation and is only the distilled lube oil that passes through. It is most effective after all other processes are used to remove contaminants, including metals.

3.5 Wastes Generated from Re-Refining Processes

There is a common group of waste products associated with all processing and re-refining operations. These commonly generated wastes are: settled sludges, wastewater, spent clays, distillation bottoms, and filter cakes.

Settled Sludges

Settled sludges can result from storage of used oil or as part of the processing to remove water and solids from the oil. The bottom sediment and water content of settled sludges ranges from 30 to 90 percent. Some collectors and processors do not acknowledge the presence of settled material; instead, they routinely pump their tanks dry. Other processors separate this material and pass it on to a more sophisticated processor for additional treatment and oil recovery.

Wastewater

During processing, a distinct free-water fraction is separated from used oils. This is in addition to the water which is tied up in oil-emulsions which comprise much of a settled sludges. The differences in wastewater composition and used oil composition are dependent upon the solubility of the constituents in the water and oil phases.

The metals remain in the oil rather than the wastewater. A low median metals concentration in wastewater is due to a small amount of oil which remains in the separated water fraction.

Spent Clays

Clays are primarily used for lube oil polishing by re-refiners, but they find application as a used oil filtration media. Metals content is lowest in spent clays used to polish lube oils from distillation/clay re-refining processes. The highest levels are reported for clay used in contact filtration processing and chemical treatment/clay bead re-refining. Intermediate levels result from acid/clay re-refining facilities. Most spent clays have insignificant levels of chlorinated and aromatic solvents because these contaminants are separated from the used oil prior to contacting the clay.

Higher weight hydrocarbons such as PCBs (polychlorinated biphenyls) and PNAs (polynuclear aromatics) may be present in spent clay at levels directly related to their concentration in the used oil. Therefore, significant contamination by these constituents is possible.

Distillation Bottoms

Re-refiners who use distillation processes generate distillation bottoms which may be marketed as asphalt extenders or disposed of in some manner. The distillation process concentrates the metals from the used oil into the bottoms material. Therefore, the metals content is directly related to levels in the used oil.

Other Wastes Generated

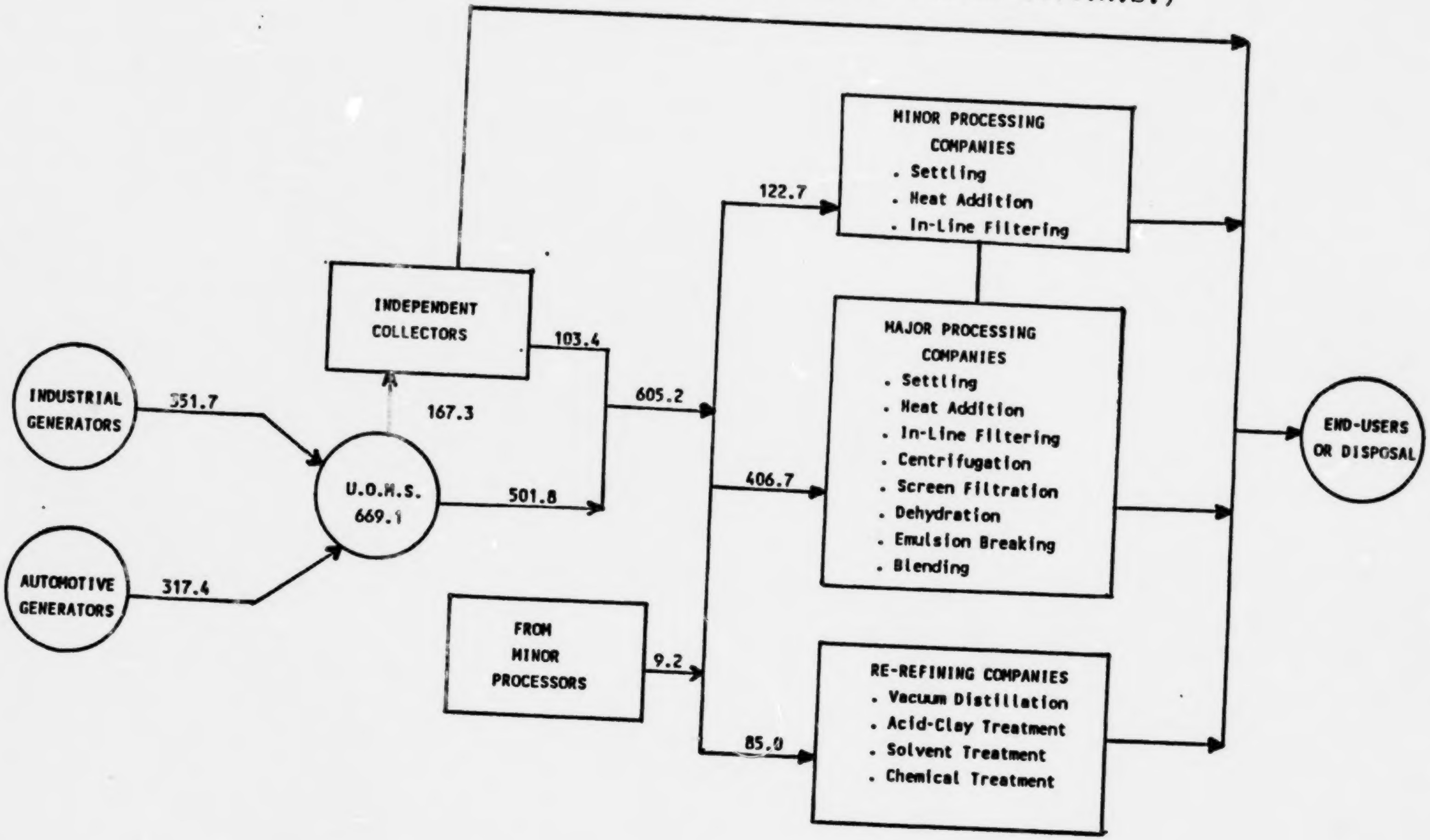
In addition to the four major wastes discussed, re-refiners and processors generate several others. They are as follows:

- tank bottoms from storage/settling tanks
- solvent sludges from re-refining
- acid sludge from re-refining
- ultrafiltrate solids
- centrifuge sludge
- activated carbon from re-refining
- filter cake from re-refining
- filter sludge from screen filtration

All of these materials are contaminated by heavy metals. Lead concentrations are particularly high, with concentrations above 10,000 ppm common for some of the re-refining sludges and filter cakes. The simple screen filtration processes are not efficient methods to remove metals from used oil, so those sludges have the lowest metal concentration of these residues.

FIGURE 3.1

USED OIL FLOW INTO THE USED OIL MANAGEMENT SYSTEM (U.O.M.S.)


INDUSTRIAL GENERATORS
351.7
AUTOMOTIVE GENERATORS
317.4
U.O.M.S. 669.1
167.3
INDEPENDENT COLLECTORS
103.4
501.8
605.2
FROM MINOR PROCESSORS
9.2
122.7
406.7
85.0
MINOR PROCESSING COMPANIES
. Settling
. Heat Addition
. In-Line Filtering
MAJOR PROCESSING COMPANIES
. Settling
. Heat Addition
. In-Line Filtering
. Centrifugation
. Screen Filtration
. Dehydration
. Emulsion Breaking
. Blending
RE-REFINING COMPANIES
. Vacuum Distillation
. Acid-Clay Treatment
. Solvent Treatment
. Chemical Treatment
END-USERS OR DISPOSAL

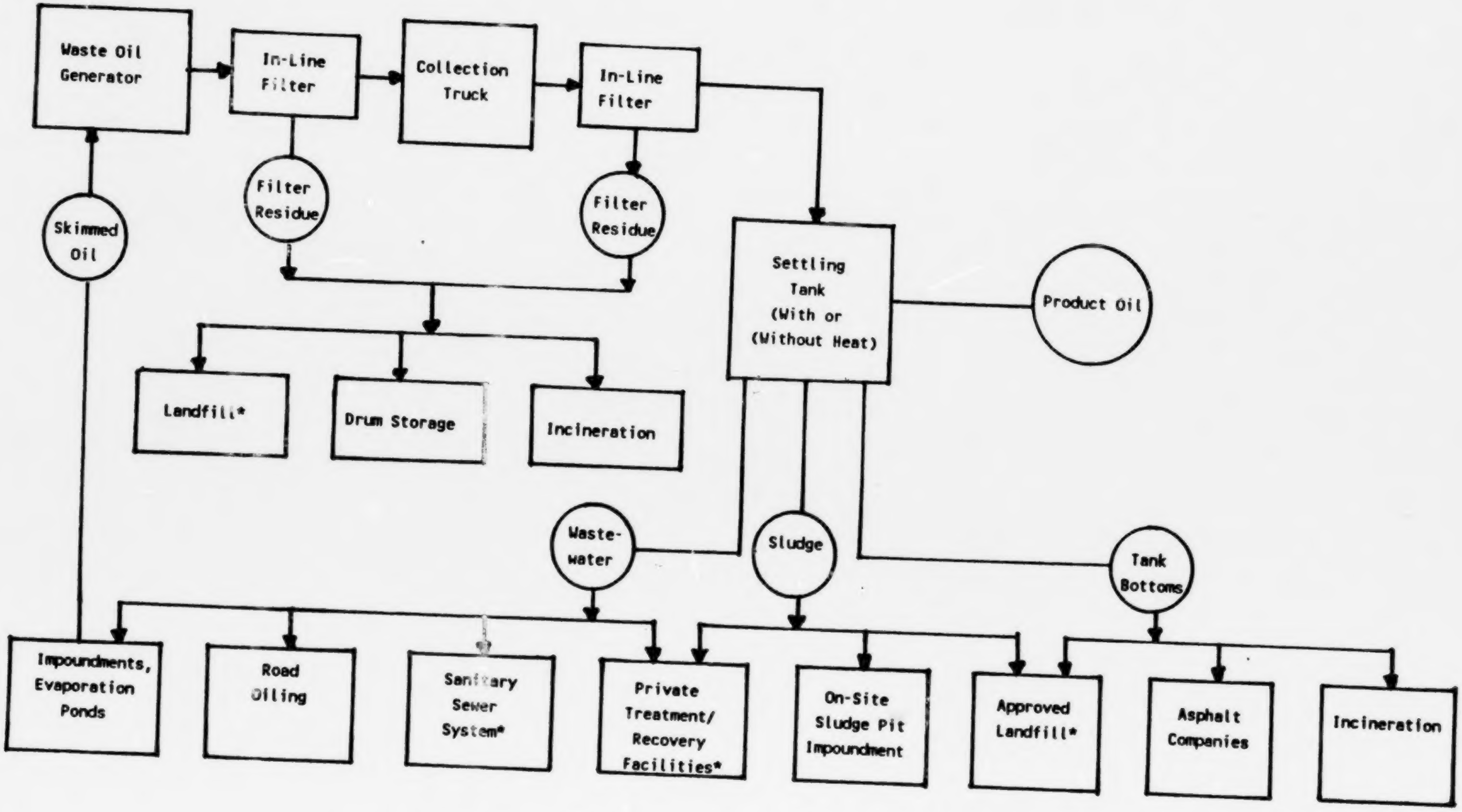
* Does not include automotive oil which is not recovered from DIYers.

** Values are millions of gallons per year (based on 1983 estimates)

Source: Modified from Franklin Associates; "Composition and Management of Used Oil Generated in the United States", 1984

FIGURE 3.2

MINOR PROCESSOR SCHEMATIC

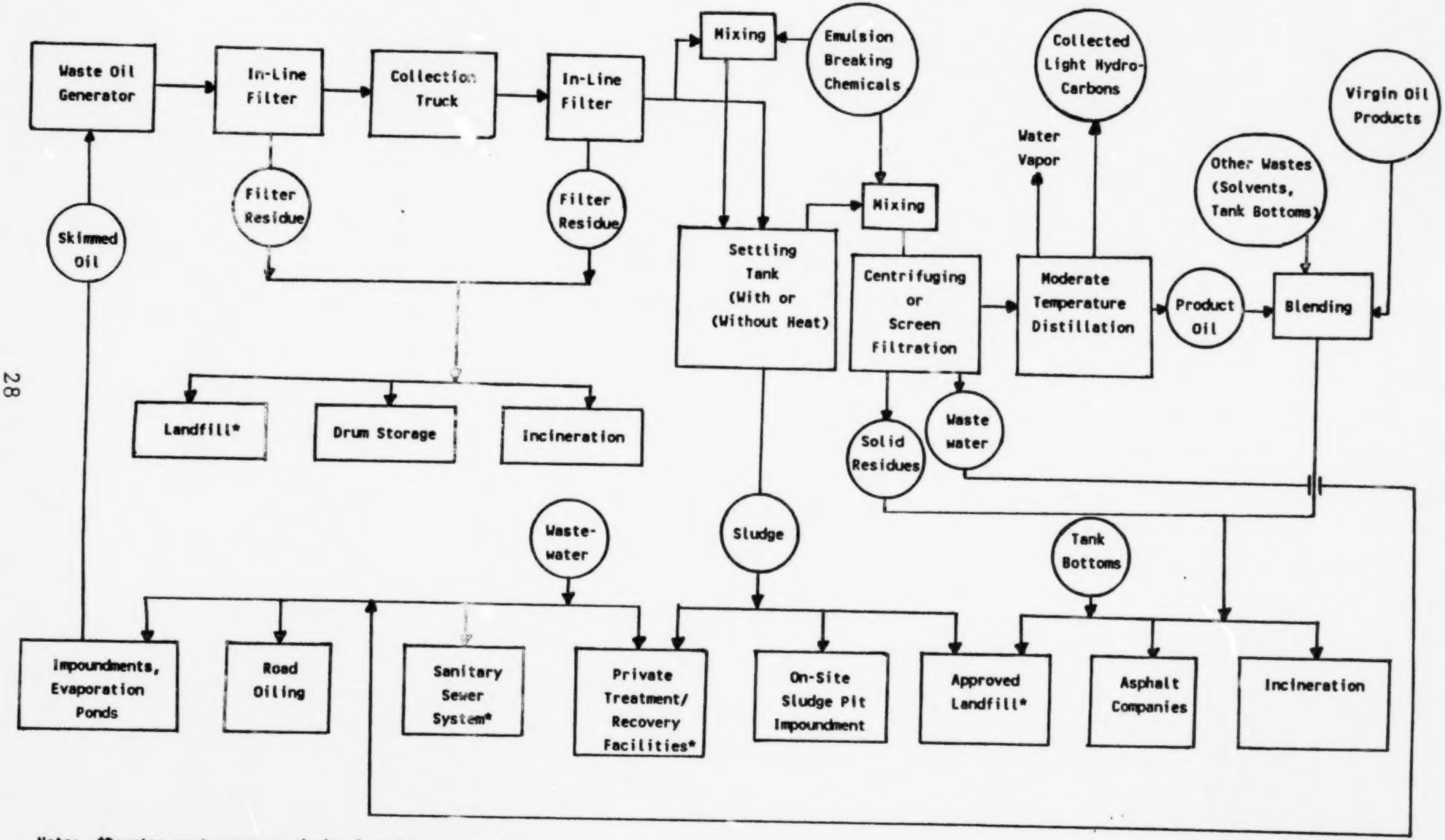

Waste Oil Generator
In-Line Filter
Collection Truck
In-Line Filter
Filter Residue
Filter Residue
Skimmed Oil
Settling Tank (With or (Without Heat)
Product Oil
Landfill*
Drum Storage
Incineration
Waste-water
Sludge
Tank Bottoms
Impoundments, Evaporation Ponds
Road Oiling
Sanitary Sewer System*
Private Treatment/ Recovery Facilities*
On-Site Sludge Pit Impoundment
Approved Landfill*
Asphalt Companies
Incineration

Note: * Denotes most common methods of residue management.

Source: Modified from Franklin Associates; "Composition and Management of Used Oil Generated in the United States", 1984

FIGURE 3.3

MAJOR PROCESSOR SCHEMATIC

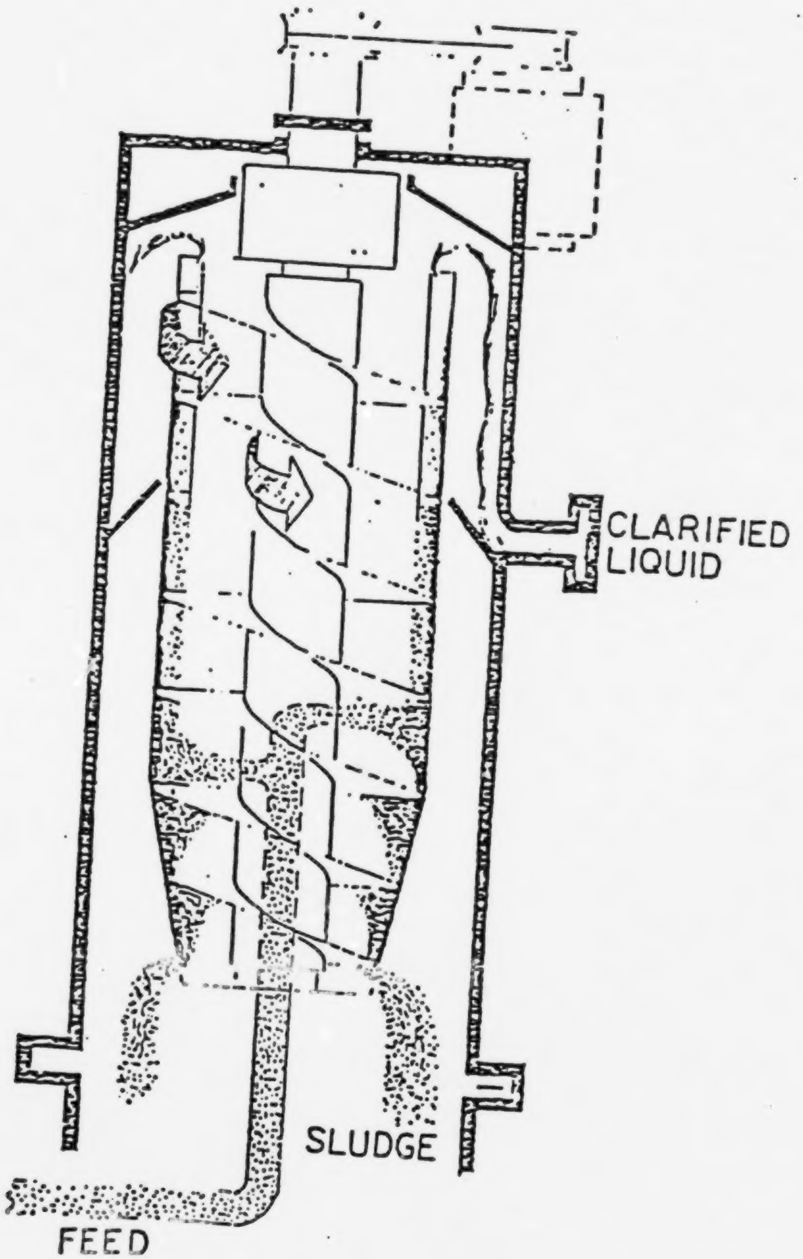

Waste Oil Generator
In-Line Filter
Collection Truck
In-Line Filter
Mixing
Emulsion Breaking Chemicals
Collected Light Hydro-Carbons
Virgin Oil Products
Water Vapor
Other Wastes (Solvents, Tank Bottoms)
Skimmed Oil
Filter Residue
Filter Residue
Settling Tank (With or (Without Heat)
Mixing
Centrifuging or Screen Filtration
Moderate Temperature Distillation
Product Oil
Blending
Landfill*
Drum Storage
Incineration
Solid Residues
Waste water
Waste-water
Sludge
Tank Bottoms
Impoundments, Evaporation Ponds
Road Oiling
Sanitary Sewer System*
Private Treatment/ Recovery Facilities*
On-Site Sludge Pit Impoundment
Approved Landfill*
Asphalt Companies
Incineration

Note: *Denotes most common methods of residue management.

Source: Modified from Franklin Associates; "Composition and Management of Used Oil Generated in the United States", 1984

FIGURE 3.4

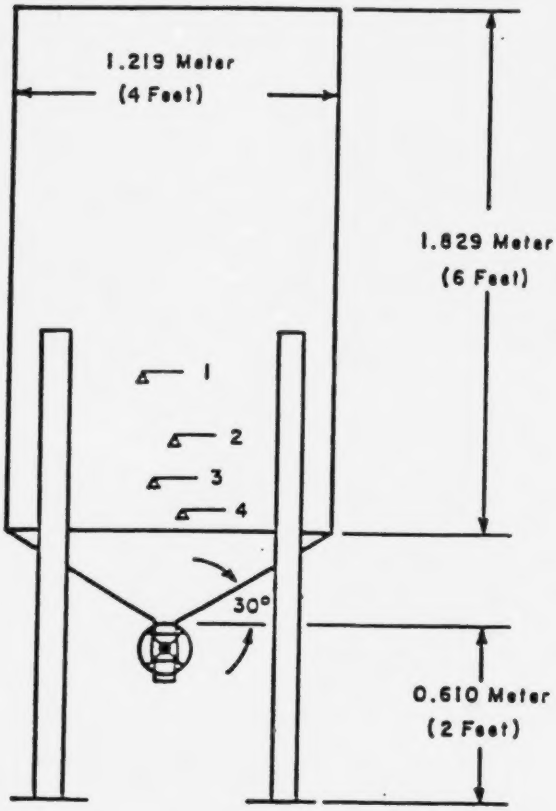
VERTICAL CENTRIFUGE SCHEMATIC


CLARIFIED
LIQUID
SLUDGE
FEED

Source: D.O.E. "Comparison of Sludge Separation Processes in the BERC Used Lubricating Oil Re-Refining Process", 1979

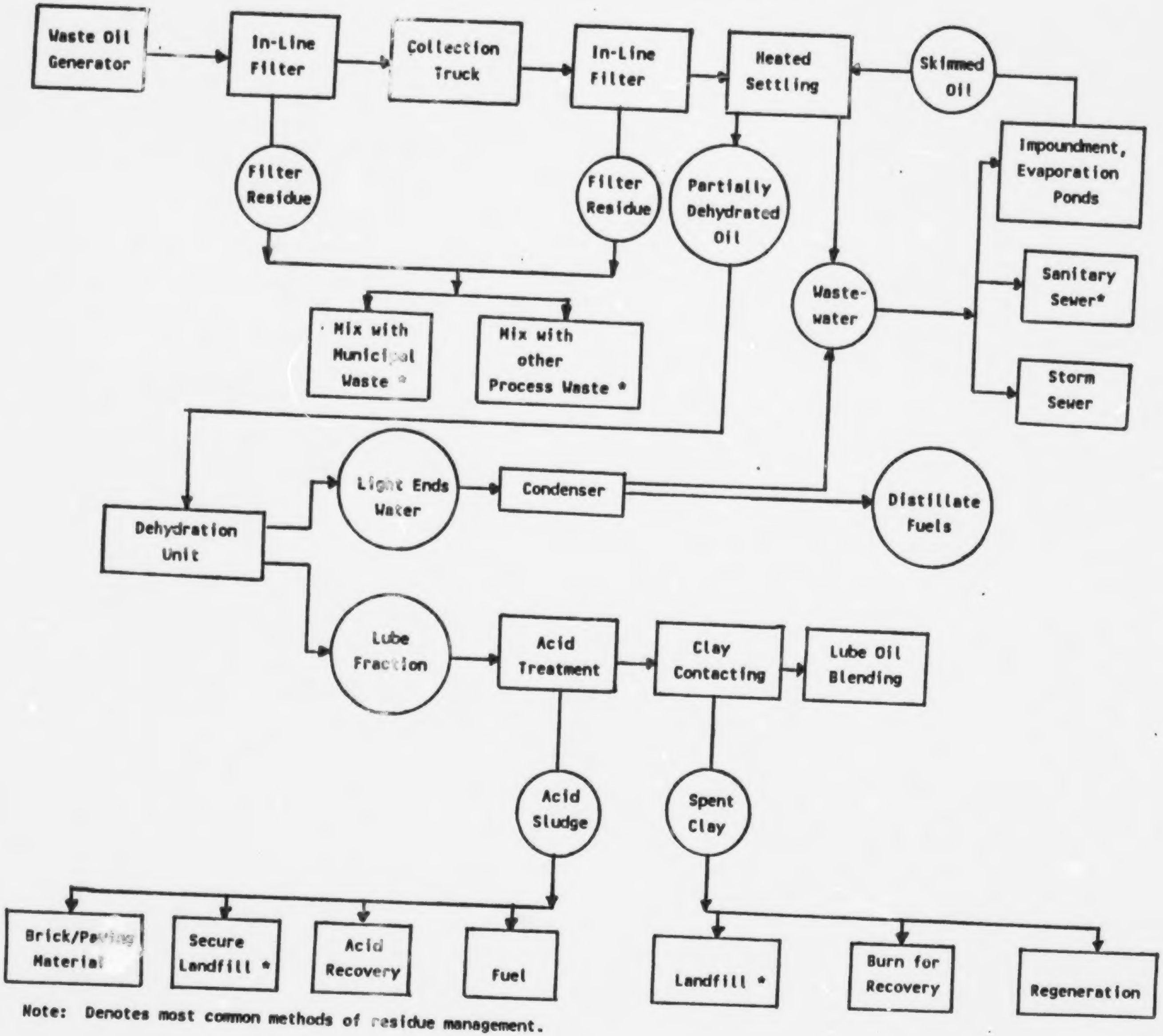
FIGURE 3,5

SOLVENT TREATMENT TANK


1.219 Meter
(4 Feet)
1.829 Meter
(6 Feet)
1
2
3
4
30°
0.610 Meter
(2 Feet)

Source: D.O.E. "Comparison of Sludge Separation Processes in the BERC Used Lubricating Oil Re-Refining Process", 1979

FIGURE 3.6
ACID CLAY RE-REFINER

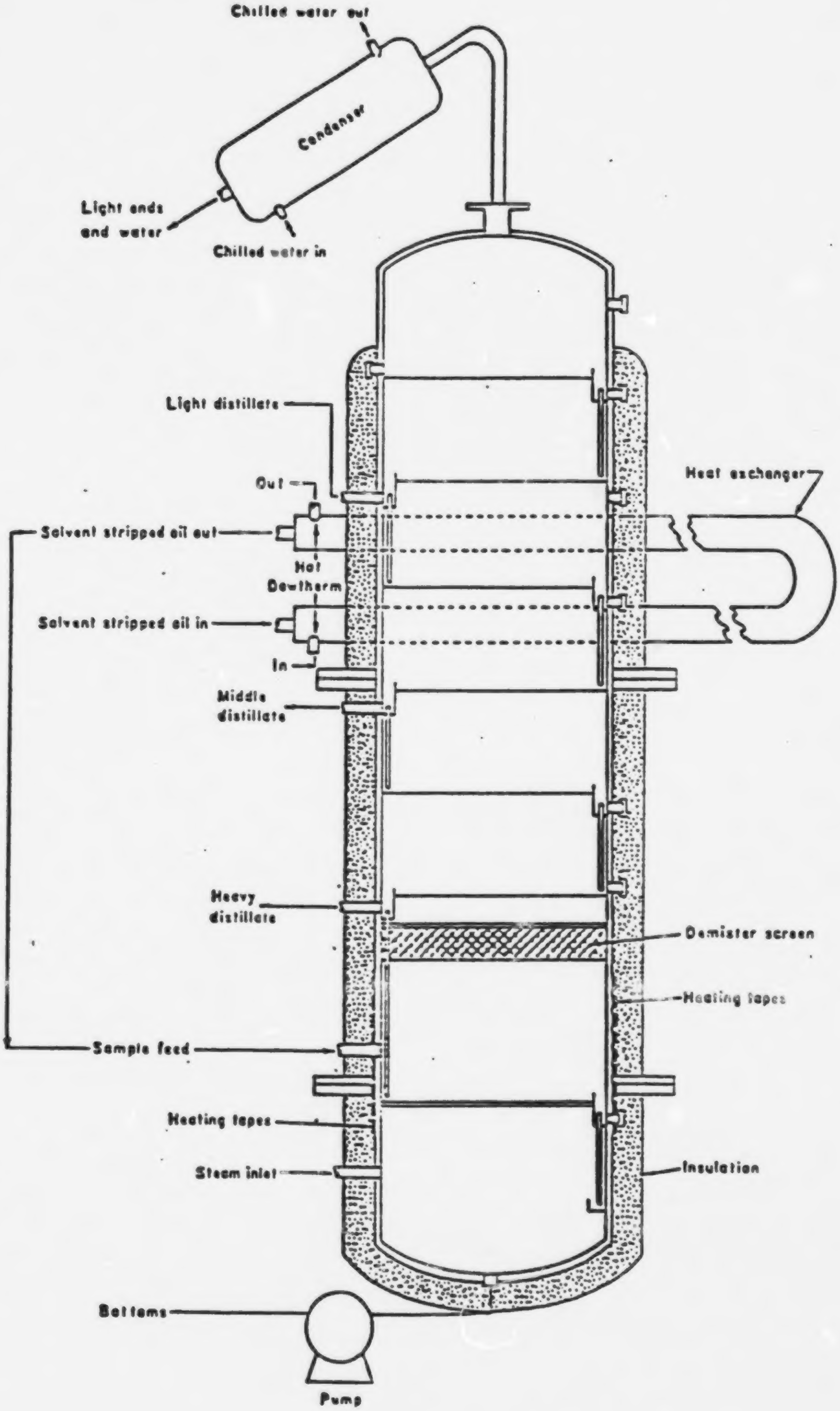

Waste Oil Generator
In-Line Filter
Collection Truck
In-Line Filter
Heated Settling
Skimmed Oil
Impoundment, Evaporation Ponds
Sanitary Sewer*
Storm Sewer
Filter Residue
Filter Residue
Partially Dehydrated Oil
Waste-water
Mix with Municipal Waste *
Mix with other Process Waste *
Dehydration Unit
Light Ends Water
Condenser
Distillate Fuels
Lube Fraction
Acid Treatment
Clay Contacting
Lube Oil Blending
Acid Sludge
Spent Clay
Brick/Paving Material
Secure Landfill *
Acid Recovery
Fuel
Landfill *
Burn for Recovery
Regeneration

Note: Denotes most common methods of residue management.

Source: Modified from Franklin Associates; "Composition and Management of Used Oil Generated in the United States", 1984

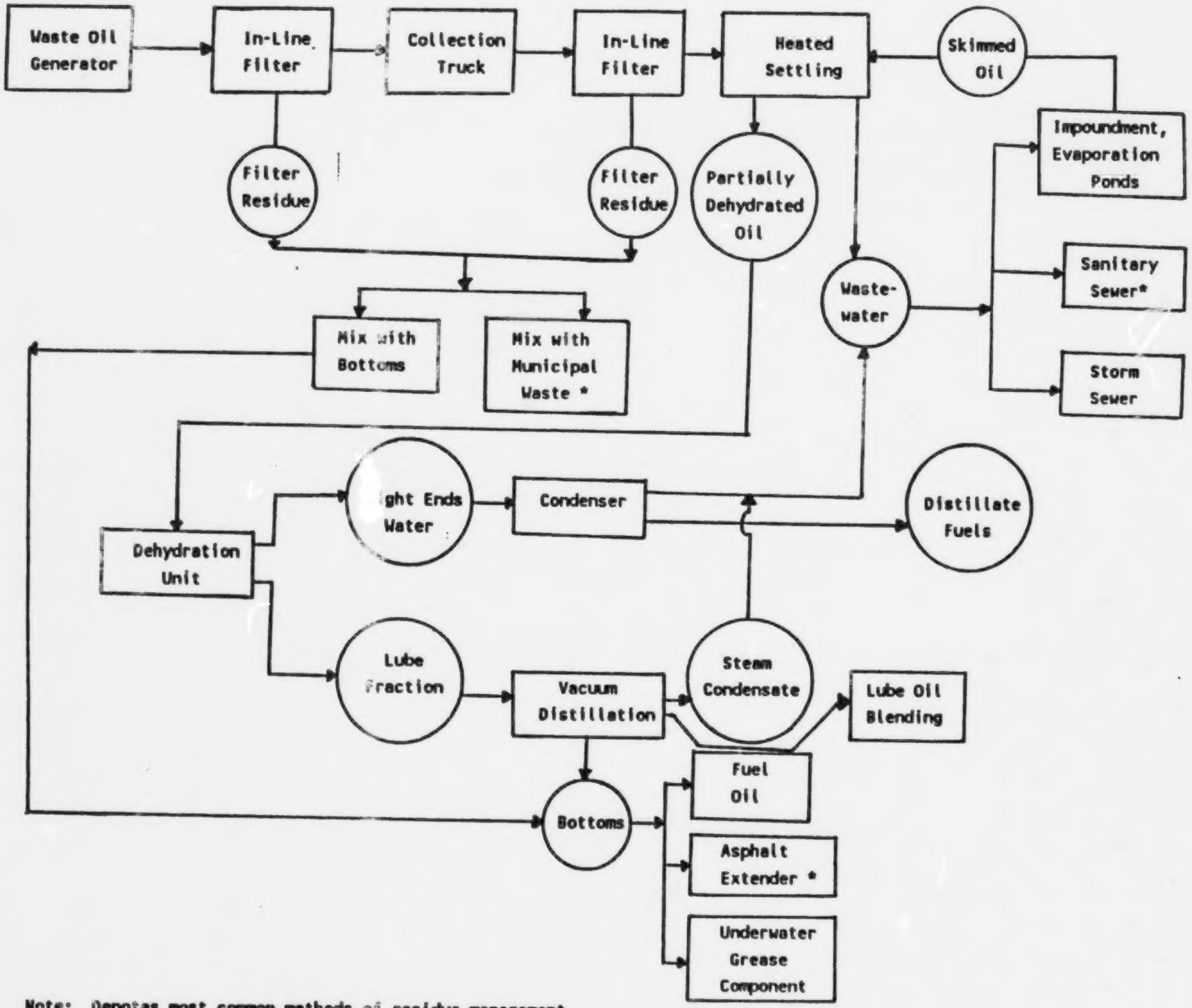
FIGURE 3.7

SEVEN-PLATE DISTILLATION TOWER


Chilled water out
Condenser
Light ends and water
Chilled water in
Light distillate
Out
Heat exchanger
Solvent stripped oil out
Hot Dowtherm
Solvent stripped oil in
In
Middle distillate
Heavy distillate
Demister screen
Heating tapes
Sample feed
Heating tapes
Steam inlet
Insulation
Bottoms
Pump

Source: D.O.E. "Comparison of Sludge Separation Processes in the BERC Used Lubricating Oil Re-Refining Process", 1979

FIGURE 3.8
VACUUM DISTILLATION RE-REFINER


Waste Oil Generator
In-Line Filter
Collection Truck
In-Line Filter
Heated Settling
Skimmed Oil
Filter Residue
Filter Residue
Partially Dehydrated Oil
Impoundment, Evaporation Ponds
Waste-water
Sanitary Sewer*
Storm Sewer
Mix with Bottoms
Mix with Municipal Waste *
Light Ends Water
Condenser
Distillate Fuels
Dehydration Unit
Lube Fraction
Vacuum Distillation
Steam Condensate
Lube Oil Blending
Fuel Oil
Bottoms
Asphalt Extender *
Underwater Grease Component

Note: Denotes most common methods of residue management.

Source: Modified from Franklin Associates; "Composition and Management of Used Oil Generated in the United States", 1984

Table 3.1: Industry Profile - Processors/Reclaimers

Facility No.	Name/Location	Dun & Bradstreet	State Contact
P-1	Auburn University University, AL		X
P-2	Capitol Fuel Co. Hanceville, AL	X	
P-3	Oil Reclamation, Inc. Muscle Shoals, AL	X	
P-4	Performance Advantage, Inc. Weogufka, AL	X	
P-5	Crosby & Overton, Inc. Long Beach, CA		X
P-6	H & H Ship Service Co. San Francisco, CA		X
P-7	Leach Oil Co., Inc. Compton, CA		X
P-8	Oil Process Co./Oil Inc. Los Angeles, CA		X
P-9	Omega Oil Co. Pomona, CA	X	X
P-10	Triad Marine/Ind. Cleaning Corp. San Diego, CA		X
P-11	Waste Oil Recovery Systems, Inc.		X
P-12	Advance Petroleum Inc. Conley, GA	X	
P-13	Citgo Petroleum Corp. Cicero, IL		X
P-14	Core-Lube, Inc. Georgetown, IL		X
P-15	American Recovery Co., Inc. East Chicago, IL		X

TABLE 3.1 (cont'd)

Industry Profile - Processors/Reclaimers

Facility No.	Name/Location	Dun & Bradstreet	State Contact
P-16	Bentex Corp. East Chicago, IN	X	
P-17	Oil Technology, Inc. Hobart, IN	X	
P-18	Reclaimed Energy Co. Indianapolis, IN		X
P-19	Wayne Reclamation & Recycling Columbia City, IN		X
P-20	Oil Reclaiming Co., Ltd. Seward, KS	X	
P-21	Amber Oil Process Co., Inc. Highland, MI	X	
P-22	Edwards Oil Service, Inc. Detroit, MI	X	
P-23	Econ, Inc. Bismarck, ND	X	X
P-24	General Crude Processing Flora Vista, NM	X	
P-25	Buckeye Amber Oil, Inc. Woodville, OH	X	
P-26	Keenan Oil Co. Cincinnati, OH		X
P-27	Baumgardner Oil Co. Fayetteville, PA		X
P-28	Petrocon Corp. Feasterville, PA		X
P-29	Gross Lab Greer, SC		X

TABLE 3.1 (cont'd)

Industry Profile - Processors/Reclaimers

Facility No.	Name/Location	Dun & Bradstreet	State Contact
P-30	Stablex Racquel, SC		X
P-31	Renewable Energy Corp. Manvel, TX	X	
P-32	Golden Eagle Refinery, Inc. Woods Cross, UT		X
P-33	Intermountain Oil Co. Woods Cross, UT		X
P-34	Solvex USA, Inc. Alexandria, VA		X
P-35	Chemical Processors, Inc. Seattle, WA	X	
P-36	Fuel Processors, Inc. Woodland, WA	X	
P-37	Petroleum Reclaiming Services Tacoma, WA	X	
P-38	Tri-State Oil Reclaimers Newcastle, WY		X

Table 3.2: Industry Profile - Re-Refiners

Facility No.	Name/Location	Dun & Bradstreet	State Contact	A.P.R.
R-1	California Oil Recyclers, Inc. San Carlos, CA	X	X	X
R-2	Demenno-Kerdoon Compton, CA		X	
R-3	KTI Group/Used Oil Division Irvine, CA			X
R-4	Lubrication Company of America Los Angeles, CA	X	X	
R-5	Nelco Oil Refining Corp. National City, CA		X	
R-6	Petroleum Recycling, Inc. Signal Hill, CA		X	
R-7	Talley Brothers, Inc. Huntington Park, CA	X	X	
R-8	Davis Refining Corp. Tallahassee, FL		X	X
R-9	Coastal Refining Corp. Savannah, GA	X	X	
R-10	Moreco Energy, Inc. Springfield, IL	X	X	
R-11	Moreco Energy, Inc. McCook, IL		X	X
R-12	Cam-Or, Inc. Westville, IN	X	X	X
R-13	Consolidated Recycling Co. Inc. Troy, IN	X	X	X
R-14	ILWD, Inc. Indianapolis, IN		X	
R-15	Midland Refining Witchita, KA		X	

TABLE 3.2 (cont'd)

Industry Profile - Re-Refiners

Facility No.	Name/Location	Dun & Bradstreet	State Contact	A.P.R.
R-16	Louisiana Oil Re-Refining Co. Baton Rouge, LA	X		
R-17	Dearborn Refining Co. Dearborn, MI	X		
R-18	Warden Oil Co. Minneapolis, MN		X	X
R-19	Amoco Petroleum Additives Natchees, MS		X	
R-20	Midwest Oil Refining Co., Inc. St. Louis, MO	X		X
R-21	Booth Oil Co., Inc. Buffalo, NY	X	X	X
R-22	Double Eagle Refining Co. Oklahoma City, OK			
R-23	Merit U.S.A. Portland, OR	X	X	
R-24	Berks Associates, Inc. Douglassville, PA	X	X	
R-25	Petrocon Corp. Modena, PA		X	
R-26	Cam-Or of Texas, Inc. Houston, TX	X	X	X
R-27	Crozier-Nelson Chemicals Houston, TX		X	
R-28	Gurley Refining Co., Inc. Kilgore, TX	X		
R-29	Moreco Energy, Inc. Houston, TX	X		
R-30	Eko-Tek Lube, Inc. Salt Lake City, UT		X	

Chapter 4

WASTE CHARACTERIZATION

4.1 Waste Characterization Objectives

This section presents information on the various aspects of a combined wastewater and solid waste screen sampling program at four (4) re-refineries. The purpose of the program was to gather data on the types and levels of pollutants, and to characterize selected waste streams generated within the re-refinery oil recycling source category. A similar screen sampling program may be undertaken for the reclaimer (processor) oil recycling source category.

It is noted that re-refinery anonymity has been maintained in the presentation of the results. This was specifically requested by those re-refiners who participated.

4.2 Sampling Strategy

From the outset of the study it was realized that sample data acquisition would be an important aspect of the program. For this reason, this particular phase of the project was planned and reviewed by the project team well in advance of the actual field sampling task.

Pre-sampling interviews with the designated re-refinery contacts yielded information on the potential number and types of samples available. This information was used as an aid to the logistical planning of the sampling program. Table 4.1 provides general re-refinery information.

Process and flow schematic diagrams were not available for inclusion in this version of the document. However, the analytical data presented in Appendix A are documented by each type of waste stream sampled at each facility. The waste streams are indicative of the types of process technologies at each facility.

As the analytical results in Section 4.4 indicate, a total of 48 screen sampling pollutant sets were collected at the four re-refining facilities sampled. Eleven distinct wastestreams were sampled, of which six (6) were water related (pretreated influents, scrubber effluent, dissolved air flotation effluent, filter effluent, stripper effluent, and end-of-pile effluent); and five (5) were solids (distillation bottoms, spent clay, filter cake, spent carbon, and DAF sludge). Section 4.4 presents the analytical results for pollutant types and wastestreams on a facility-by-facility basis.

Analytes Selected

The analytes selected for testing were those on various regulatory lists, including, but not limited to priority pollutants appendix C list, and analytes specific to ITD programs. As indicated in the matrix provided in Table 4.2, the list included conventionals, non-conventionals, ICP & AA metals, ICP screening metals, RCRA characteristics, including dioxins and furans, and organics. Tables 4.3 through 4.5 , located at the end of this chapter, present the lists of the specific analytes tested for in the project.

The organic and metals analytes are further subclassified according to the analytical method employed. Volatiles is that fraction of the organic analytes which is purged from the waters and sludges for determination by GCMS, whereas semi-volatiles is that fraction that has been extracted. Organic analytes are specific chemical compounds based on carbon chemistry; metals are chemical elements, substances that cannot be divided without altering their physical and chemical properties; and for the most part, the conventional pollutants are those chemical substances that have historically been used to assess the performance of water treatment plants and for assessing water quality.

In addition, certain sample sets were leached using EPA's Toxicity Characteristic Leaching Procedure (TCLP). The leachate extracts from this procedure were tested for a subset of organics and metals.

Sampling Activities

Sampling was conducted in September and December of 1986 and in March of 1987. The sampling periods lasted from two to three consecutive days, between Monday and Friday of the week. Depending on process and wastestream configurations, and on operations in effect at the time sampling was conducted, the samples were either 24 hour composites or grab type samples. Grab samples for volatile organics (VOA's) was always the rule. Grab samples were also taken where prescribed by EPA's sampling protocol.

On occasion, as dictated by sample point configuration, samples were grabbed via an intermediate vessel. This method of sampling is a modification to the protocol for fractions such as oil and grease and volatile organics where the sample container is supposed to be filled directly from the wastewater stream. This modification was necessitated for safety and practical reasons. In all cases where an intermediate beaker was used, it was used exclusively at one point for the duration of sampling at the facility; it was repeatedly purged with fresh sample before each sample was collected.

Sample points within each facility were selected so that the water and solid streams sampled best characterized the wastestreams from which they were taken. While in some instances they may appear self explanatory, the following briefly describes the sample streams collected:

Water Sampling

- Influent - untreated process waste waters
- Scrubber Effluent - flue gas scrubber water
- DAF Effluent - water effluents from a DAF
- Filter Effluent - water effluents from a filtration system
- Stripper Effluent - sour water stripper effluent
- End-of-Pipe Effluent - final discharge to sanitary sewer system

Solids Sampling

- Distillation Bottoms - asphalt flux extender
- Spent Clay - waste clay resulting from various lube oil polishing practices
- Filter Cake - waste clay resulting from various clay contact filtration practices
- Spent Carbon - activated carbon treatment wastes
- DAF Sludge - skimmed sludge from DAF system

4.3 Analytical Methods

Analyses Performed

Samples were tested by laboratories using EPA analytical methods. Nearly all of these methods are either approved wastewater methods (CWA 304(h)), proposed or approved methods for testing wastes (RCRA SW-846, TCLP), or Superfund Contract Laboratory Program methods. The methods used are summarized in Table 4.6, which is provided at the end of this chapter. In selecting between available methods, EPA chose methods that it believed would produce results meeting Project requirements. The SW-846 and 304(h) methods were drawn upon most heavily because of their direct applicability to the samples that were expected to be encountered. Other consideration were:

- EPA's experience in managing laboratories using a given method or method set. For example, EPA has used Methods 1624 and 1625 in testing untreated and treated waste waters and in-process streams from a diversity of industries since 1980 and thus has extensive experience in applying the methods to samples containing the complex mixtures of organic compounds that were anticipated in the Project.

- Having contracts in place that would permit the analyses to be performed in accordance with the Project schedule. At the time of Project inception, ITD had in place contracts for testing the organic, metal, and inorganic analytes requires for this Project. Alternate methods would have necessitated contract modifications or award of new contracts.

- Quality assuring results with these methods. ITD has in place a computerized system for quality assuring results from analysis using Methods 1624 and 1625. Although it would have been possible to apply the QA system to analysis of the same list of organic analytes using SW-846 or superfund CLP methods, ITD had extensive experience with the quality assurance system using Methods 1624 and 1625, and would have had to proof-test the QA system with alternative methods prior to their use.

Data Quality Considerations

Analytical data can provide meaningful results only if accurate records are kept of the samples that have been collected, the location and techniques of collection, and any process or treatment system conditions that could affect analytical results. All sampling for the project was performed by Data Technology Research, Inc. in accordance with applicable Agency procedures.

Quality of laboratory analyses was assured by the quality assurance department in each individual laboratory. Results from each laboratory were further quality assured by the EPA Sample Control Center (SCC). Information flow related to sampling, sample analysis, data reporting, data validation, and statistical analysis was controlled by Sample Control Center.

4.4 Sampling Program Results

Sampling QA/QC

The objectives of the sampling portion of the Project were to collect technical information and samples at the designated sites. All sampling activities were conducted in accordance with site specific sampling plans and the overall Project Sampling Quality Assurance/Quality Control Plan.

The sample tracking system was quality assured. Each sample container included EPA's Sample Control Center code number, bottle number, source, collection date, fractions to be analyzed, and preservatives used. SCC Traffic Reports were completed for all sample sets and accompanied each sample shipment to its appropriate laboratory. Laboratory Chronicles, data sheets, magnetic tapes, magnetic disks, and all other entities relating to each sample were maintained by the responsible agent.

Information about daily sampling activities were recorded in field logbooks. Any unusual occurrences in facility operations or in sampling procedures that could affect analytical results or sample validity were noted. If any changes from standard field protocols were necessary, they, too, were documented.

The following section provides summaries of the data collected at the four rerefiners sampled. The Agency will be evaluating and interpreting the analytical data as part of the continuing efforts for this industry review. This report draws no conclusions or inferences from the data compiled at this point. Interpretations and findings derived from the data will be contained in future reports that will be available for public comment.

A somewhat detailed summary, including EPA Sample Control Center (SCC) sample number, episode number, sample location, collection method, etc., is provided in Table 4.7, which is also located at the end of this chapter.

Analytical results are presented in Appendix A, Tables A-1 through A-32. A summary of the sequence in which the data is presented is as follows:

Index of Data Tables

Appendix A Table Numbers	Chemical Analyses
A-1 through A-9	Conventional/Non-Conventional Parameters
A-1 through A-4	Water Samples Results by Facility
A-5 through A-9	Solid Samples Results by Waste Stream Type
A-10 through A-18	Organics (Volatiles, Semi-Volatiles)
A-10 through A-13	Water Samples Results by Facility
A-14 through A-18	Solid Samples Results by Waste Stream
A-19 through A-27	Metals (ICP Screening, ICP & AA Metals)
A-19 through A-22	Water Samples Results by Facility
A-23 through A-27	Solid Samples Results by Waste Stream Type
A-28 through A-32	RCRA Characteristics (TCLP Organics and Metals, Dioxins, PCB's) by Solids Waste Stream Type

4.5 Additional Waste Related Information

Toxic Constituents of Concern

As indicated in the literature, used oil typically contains a number of toxicants in concentrations well above those necessary to cause harm. These constituents, including lead, trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, napthalene, and toluene, have been measured in used oils. Previous Agency surveys have shown the occurrence of the following contaminant levels; lead at 1200 ppm, naphthalene at 990 ppm, tetrachloroethylene at 1300 ppm, 1,1,1-trichloroethane at 3100 ppm, trichloroethylene at 1000 ppm and toluene at 5000 ppm. In used oil, therefore, these constituents are present at levels of from 10^2 to 10^7 higher than any health based standards as indicated in Table A-33. Therefore, only a small percentage of the toxicants would need to migrate from the was the waste and escape into the environment at levels above the reported health-based standards.

Mobility Potential

The water solubility of a given toxic constituent is indicative of its mobility potential (i.e., the likelihood that it will be released from a management site and become dissolved in a water resource of concern). The used oil constituents of concern are highly water soluble and thus characterized by a high mobility potential. The solubilities are many orders of magnitude greater than their respective Ambient Water Quality Criteria levels and designated Drinking Water Standards. If improperly managed, these toxicants can be expected to migrate from storage or disposal facilities and to become dissolved in drinking water resources at levels exceeding applicable health standards.

For example, trichloroethylene is soluble in water at concentrations which exceed the long-term Suggested No Adverse Response Level (SNARL) by a factor of approximately 13,000. If improperly managed, leachate from wastes containing trichloroethylene could migrate to water supplies resulting in concentration levels far in excess of the corresponding long-term SNARL. Tetrachloroethylene is similarly very soluble in water at concentrations exceeding the long-term SNARL by a factor of 75,000. Furthermore, since the used oil itself is a liquid, the potential for these toxicants to migrate from the waste is enhanced. Therefore, these toxicants are likely to escape from the waste and migrate into ground water to present a substantial hazard to human health and the environment.

Persistence

Many of these constituents are highly persistent in the environment (e.g., 1,1,1-trichloroethane has a half-life of 5-9 months in fresh water and 39 months in sea water and tetrachloroethylene has a residence time of several years or decades in deep soils and ground water). Metals, such as arsenic, cadmium, chromium, and lead will persist in the environment indefinitely.

The Agency considers a material to be persistent if it persists in the environment long enough to be detected since it may also result in exposure to humans in the same period of time. Most of these constituents have been repeatedly detected in ground and surface water surveys conducted by the Agency which provides a further indication of their environmental persistence. For example, in one Agency survey of 969 water systems, 1.4 percent of tap water samples exceeded the 50 ppb standard for lead. Similarly, naphthalene has been detected in natural waters and in drinking water supplies.

In nationwide surveys of organic chemicals in the drinking water of representative U.S. communities, toluene was found to contaminate one raw and eleven finished water supplies out of the 133 water supplies surveyed. Toluene has also been detected in sea water and fish obtained near petroleum and petrochemical plants in Japan.

Four Federal surveys used to estimate levels of 1,1,1-trichloroethane in public drinking water supplies in the U.S. reported that 3 percent of the groundwater systems are expected to have between 0.5 - 5 ppb of 1,1,1-trichloroethane, and that most surface water systems have detectable levels of 1,1,1-trichloroethane. Many of these constituents, including used oil itself, have been found to migrate and present a hazard to human health and the environment at Superfund sites.

The toxicologic properties, environmental mobility, and persistence of these toxicants are described in the corresponding Health and Environmental Effects Profiles. We note further, however, that a consideration of the toxicity of individual waste constituents is likely to understate waste toxicity. This understatement relates to the fact that used oils comprise complex mixtures of many hazardous constituents. Aggregate toxic effects, whether additive or synergistic, are likely manifestations of exposure.

Another factor which the Administrator considers in the decision to list a waste as hazardous concerns "the degree to which the constituent or any toxic degradation product of the constituent bioaccumulates in ecosystems." Bioaccumulation is the tendency of a substance to become concentrated in living tissue. Many of the constituents in used oil bioaccumulate in the tissues of living organisms. Naphthalene, for example, can accumulate in living tissues at concentrations up to 186 times those in the contaminated water. Toluene can accumulate in living tissues at concentrations 78 times the concentration in the water. 1,1,1-Trichloroethane, tetrachloroethylene, and trichloroethylene also bioaccumulate at 56 times, 43 times, and 15 times their respective concentrations in water. Thus, only a small fraction of the toxicants present in these wastes need migrate and reach environmental receptors to pose the potential for substantial harm to human health and the environment.

Waste Management Considerations

Used oils are capable of causing substantial harm to human health or the environment, if managed improperly.

Typical improper management practices include disposal in unlined or inadequately lined land disposal facilities leading to contamination of ground water, surface water, and soil, and improper burning, resulting in exposure to unburned toxicants in the wastes as well as products of incomplete combustion.

Appendix A of the used oil background document provides a summary of 81 major mismanagement incidents and the cost implications of cleanup operations ($10,000 to $5,150,000 per site). The mismanagement issue is not confined to on-site management of used oil, as evidenced by the fact that seventy (70) of these incidents occurred off the generation site. The media affected include surface water (35 sites), ground water (24 sites), drinking water (17 sites), air (8 sites), and soil (25 sites).

Treatment, storage, and disposal of used oils in tank and container storage facilities (25 sites), surface impoundments (36 sites), and other improper disposal facilities (35 sites), burning operations (7 sites), and use of waste oil as a dust suppressant (3 sites) have resulted in the pollution of ground or surface water with lead, chlorinated organics, or aromatic organics from these wastes.

In summary, the Agency has determined that used oil can contain toxic constituents at concentrations that are of concern, that these constituents are mobile, persistent, and bioaccumulative, and capable of migration in hazardous concentrations, and, therefore, that these wastes are capable of causing substantial harm if mismanaged.

Table 4.1: General Re-Refinery Information

Fac. ID	Date	Location	Feedstock
A	Sept. 1986	N-Cent./U.S.	Auto/Industrial
B	Sept. 1986	N-Cent./U.S.	Auto/Ind./Railroad
C	Dec. 1986	West/U.S.	Auto/Ind./Railroad
D	Jan. 1987	West/U.S.	Auto/Ind./Railroad

Table 4.2: Pollutant Fractions Analyzed by Sample Type

CONVENTIONALS	NON-CONVENTIONALS	ORGANICS	ICP & AA METALS	ICP SCREENING METALS	RCRA CHARACTERISTICS
LIQUID STREAMS	X	X **	X	X	X
SOLID STREAMS	X *	X ***	X	X	X

* Excluding TSS

** Excluding LOD

*** Excluding Conductivity and TDS

Table 4.3: Pollutant Fractions Analyzed

Conventionals

BOD
TSS
Oil & Grease
BOD
TSS
Oil & Grease
pH

Non-Conventionals

Conductivity
TDS
Cyanide
Sulfide
TVO
COD

TOC
Ammonia
Nitrate+Nitrate
Fluoride
Phenolics
Chloride

RCRA

Ignitability
Corrosivity
Reactivity
PCB's

ICP and AA Metals

Al
Sb
As
Ba
Be
B
C

Ca
Cr
Co
Cu
Fe
Pb
Mg

Mn
Hg
Mo
Ni
Se
Ag
Na

Tl
Sn
Ti
V
U
Zn

ICP Screening Metals

Al
Sb
As
Ba
Be
Bi
B
Cd
Ca
Ce
Cr
Co

Cu
Dy
Er
Eu
Ga
Ge
Au
Hf
Ho
In
I
Ir

Fe
La
Li
Lu
Pb
Mg
Mn
Hg
Mo
Nd
Ni

Nb
Os
Pd
P
Pt
K
Pr
Re
Rh
Ru
Sm

Sc
Se
Si
Ag
Na
Sr
S
Ta
Te
Tb
Tl

Th
Tm
Sn
Ti
W
U
V
Yb
Y
Zn
Zr

Table 4.4: Volatile Organics Analyzed

TABLE CODE	TESTED FOR	ANALYTE
002	1	ACROLEIN
003	1	ACRYLONITRILE
004	1	BENZENE
006	1	CARBON TETRACHLORIDE
007	1	CHLOROBENZENE
010	1	1,2-DICHLOROETHANE
011	1	1,1,1-TRICHLOROETHANE
013	1	1,1-DICHLOROETHANE
014	1	1,1,2-TRICHLOROETHANE
015	1	1,1,2,2-TETRACHLOROETHANE
016	1	CHLOROETHANE
017	1	BIS (CHLOROMETHYL) ETHER (NR)
019	1	2-CHLOROETHYLVINYL ETHER
023	1	CHLOROFORM
029	1	1,1-DICHLOROETHENE
030	1	TRANS-1,2-DICHLOROETHENE
032	1	1,2-DICHLOROPROPANE
033	1	T-1,3-DICHLOROPROPENE
038	1	ETHYLBENZENE
044	1	METHYLENE CHLORIDE
045	1	CHLOROMETHANE
046	1	BROMOMETHANE
047	1	BROMOFORM
048	1	BROMODICHLOROMETHANE
049	1	TRICHLOROFLUOROMETHANE (NR)
050	1	DICHLORODIFLUOROMETHANE (NR)
051	1	DIBROMOCHLOROMETHANE
085	1	TETRACHLOROETHENE
086	1	TOLUENE
087	1	TRICHLOROETHENE
088	1	VINYL CHLORIDE
514	1	2-BUTANONE (MEK)
515	1	DIETHYL ETHER
516	1	ACETONE
527	1	P-DIOXANE
532	2	ALLYL ALCOHOL
533	2	CARBON DISULFIDE
534	2	2-CHLORO-1,3-BUTADIENE
535	2	CHLOROACETONITRILE
536	2	3-CHLOROPROPENE
537	2	CROTONALDEHYDE
538	2	1,2-DIBROMOETHANE (EDB)
539	2	DIBROMOMETHANE
540	2	TRANS-1,4-DICHLORO-2-BUTENE
541	2	1,3-DICHLOROPROPANE
542	2	CIS-1,3-DICHLOROPROPENE
543	2	ETHYL CYANIDE
544	2	ETHYL METHACRYLATE
545	2	2-HEXANONE
546	2	IODOMETHANE
547	2	ISOBUTYL ALCOHOL
548	2	METHACRYLONITRILE
549	2	METHYL METHACRYLATE
550	2	4-METHYL-2-PENTANONE
551	2	1,1,1,2-TETRACHLOROETHANE
552	2	TRICHLOROFLUOROMETHANE
553	2	1,2,3-TRICHLOROPROPANE
554	2	VINYL ACETATE

Table 4.5: Base-Neutral and Acid Extractable Organics Analyzed

TABLE CODE	TESTED FOR	ANALYTE
BASE/NEUTRAL EXTRACTABLES		
001	1	ACENAPHTHENE
005	1	BENZIDINE
008	1	1,2,4-TRICHLOROBENZENE
009	1	HEXACHLOROBENZENE
012	1	HEXACHLOROETHANE
018	1	BIS(2-CHLOROETHYL)ETHER
020	1	2-CHLORONAPHTHALENE
025	1	1,2-DICHLOROBENZENE
026	1	1,3-DICHLOROBENZENE
027	1	1,4-DICHLOROBENZENE
028	1	3,3'-DICHLOROBENZIDINE
034	1	2,4-DIMETHYLPHENOL
035	1	2,4-DINITROTOLUENE
036	1	2,6-DINITROTOLUENE
037	1	1,2-DIPHENYLHYDRAZINE
039	1	FLUORANTHENE
040	1	4-CHLOROPHENYL PHENYL ETHER
041	1	4-BROMOPHENYL PHENYL ETHER
042	1	BIS (2-CHLOROISOPROPYL) ETHER
043	1	BIS (2-CHLOROETHOXY) METHANE
052	1	HEXACHLORO-1,3-BUTADIENE
053	1	HEXACHLOROCYCLOPENTADIENE
054	1	ISOPHORONE
055	1	NAPHTHALENE
056	1	NITROBENZENE
061	1	N-NITROSODIMETHYLAMINE
062	1	N-NITROSODIPHENYLAMINE
063	1	N-NITROSODI-N-PROPYLAMINE
065	1	PHENOL
066	1	BIS (2-ETHYLHEXYL) PHTHALATE
067	1	BUTYL BENZYL PHTHALATE
068	1	DI-N-BUTYL PHTHALATE
069	1	DI-N-OCTYL PHTHALATE
070	1	DIETHYL PHTHALATE
071	1	DIMETHYL PHTHALATE
072	1	BENZO(A)ANTHRACENE
073	1	BENZO(A)PYRENE
074	1	BENZO(B)FLUORANTHENE
075	1	BENZO(K)FLUORANTHENE
076	1	CHRYSENE
077	1	ACENAPHTHYLENE
078	1	ANTHRACENE

Table 4.5 (cont'd)

Base/Neutral and Acid Organics Analyzed

TABLE CODE	TESTED FOR	ANALYTE
BASE/NEUTRAL EXTRACTABLES (Continued)		
079	1	BENZO(GHI)PERYLENE
080	1	FLUORENE
081	1	PHENANTHRENE
082	1	B DIBENZO(A,H)ANTHRACENE
083	1	INDENO(1,2,3-CD)PYRENE
084	1	PYRENE
502	1	B-NAPHTHYLAMINE
503	1	ALPHA-PICOLINE
504	1	DIBENZOTHIOPHENE
505	1	DIBENZOFURAN
506	1	N-DODECANE (N-C12)
507	1	DIPHENYLAMINE
508	1	DIPHENYL ETHER
509	1	ALPHA-TERPINEOL
510	1	STYRENE
512	1	BIPHENYL
513	1	P-CYMENE
517	1	N-DECANE (N-C10)
518	1	N-TETRADECANE (N-C14)
519	1	N-HEXADECANE (N-C16)
520	1	N-OCTADECANE (N-C18)
521	1	N-EICOSANE (N-C20)
522	1	N-DOCOSANE (N-C22)
523	1	N-TETRACOSANE (N-C24)
524	1	N-HEXACOSANE (N-C26)
525	1	N-OCTACOSANE (N-C28)
526	1	N-TRIACONTANE (N-C30)
528	1	CARBAZOLE
529	1	1,2,3-TRICHLOROBENZENE
555	2	ACETOPHENONE
556	2	4-AMINOBIPHENYL
557	2	ANILINE
558	2	O-ANISIDINE
559	2	ARAMITE
560	2	BENZANTHRONE
561	2	1,3-BENZENEDIOL (RESORCINOL)
562	2	BENZENETHIOL
563	2	2,3-BENZOFLUORENE
564	2	BENZYL ALCOHOL
565	2	2-BROMOCHLOROBENZENE
566	2	3-BROMOCHLOROBENZENE
567	2	4-CHLORO-2-NITROANILINE

Table 4.5 (cont'd)

Base/Neutral and Acid Organics Analyzed

TABLE CODE	TESTED FOR	ANALYTE
BASE/NEUTRAL EXTRACTABLES (Continued)		
568	2	5-CHLORO-O-TOLUIDINE
569	2	4-CHLOROANILINE
570	2	3-CHLORONITROBENZENE
571	2	O-CRESOL
572	2	CROTOXYPHOS
573	2	2,6-DI-TERT-BUTYL-P-BENZOQINO
574	2	2,4-DIAMINOTOLUENE
575	2	1,2-DIBROMO-3-CHLOROPROPANE
576	2	2,6-DICHLORO-4-NITROANILINE
577	2	1,3-DICHLORO-2-PROPANOL
578	2	2,3-DICHLOROANILINE
579	2	2,3-DICHLORONITROBENZENE
580	2	1,2:3,4-DIEPOXYBUTANE
581	2	3,3'-DIMETHOXYBENZIDINE
582	2	DIMETHYL SULFONE
583	2	P-DIMETHYLAMINOAZOBENZENE
584	2	7,12-DIMETHYLBENZ(A)ANTHRACENE
585	2	N,N-DIMETHYLFORMAMIDE
586	2	3,6-DIMETHYLPHENANTHRENE
587	2	1,3-DINITROBENZENE
588	2	DIPHENYLDISULFIDE
589	2	ETHYL METHANESULFONATE
590	2	ETHYLENETHIOUREA
591	2	ETHYNYLESTRADIOL 3-METHYL ETHE
592	2	HEXACHLOROPROPENE
593	2	2-ISOPROPYLNAPHTHALENE
594	2	ISOSAFROLE
595	2	LONGIFOLENE
596	2	MALACHITE GREEN
597	2	METHAPYRILENE
598	2	METHYL METHANESULFONATE
599	2	2-METHYLBENZOTHIOAZOLE
901	2	4,4'-METHYLENEBIS(2-CHLOROANI)
902	2	4,5-METHYLENEPHENANTHRENE
903	2	1-METHYLFLUORENE
904	2	2-METHYLNAPHTHALENE
905	2	1-METHYLPHENANTHRENE
906	2	2-(METHYLTHIO)BENZOTHIAZOLE
907	2	1,5-NAPHTHALENEDIAMINE
908	2	1,4-NAPHTHOQUINONE
909	2	ALPHA-NAPHTHYLAMINE

Table 4.5 (cont'd)

Base/Neutral and Acid Organics Analyzed

BASE/NEUTRAL EXTRACTABLES (Continued)

TABLE CODE	TESTED FOR	ANALYTE
910	2	5-NITRO-O-TOLUIDINE
911	2	2-NITROANILINE
912	2	3-NITROANILINE
913	2	4-NITROANILINE
914	2	4-NITROBIPHENYL
915	2	N-NITROSODI-N-BUTYLAMINE
916	2	N-NITROSODIETHYLAMINE
917	2	N-NITROSOMETHYLETHYLAMINE
918	2	N-NITROSOMETHYLPHENYLAMINE
919	2	N-NITROSOMORPHOLINE
920	2	N-NITROSOPIPERIDINE
921	2	PENTACHLOROBENZENE
922	2	PENTACHLOROETHANE
923	2	PENTAMETHYLBENZENE
924	2	PERYLENE
925	2	PHENACETIN
926	2	PHENOTHIAZINE
927	2	1-PHENYLNAPHTHALENE
928	2	2-PHENYLNAPHTHALENE
929	2	PRONAMIDE
930	2	PYRIDINE
931	2	SAFROLE
932	2	SQUALENE
933	2	1,2,4,5-TETRACHLOROBENZENE
934	2	THIANAPHTHENE
935	2	THIOACETAMIDE
936	2	THIOXANTHONE
937	2	O-TOLUIDINE
938	2	1,2,3-TRIMETHOXYBENZENE
939	2	2,4,5-TRIMETHYLANILINE
940	2	TRIPHENYLENE
941	2	TRIPROPYLENEGLYCOL METHYL ETHE
942	2	1,3,5-TRITHIANE

ACID EXTRACTABLES

TABLE CODE	TESTED FOR	ANALYTE
021	1	2,4,6-TRICHLOROPHENOL
022	1	4-CHLORO-3-METHYLPHENOL
024	1	2-CHLOROPHENOL
031	1	2,4-DICHLOROPHENOL

Table 4.5 (cont'd)

Base/Neutral and Acid Organics Analyzed

TABLE CODE	TESTED FOR	ANALYTE
ACID EXTRACTABLES (Continued)		
057	1	2-NITROPHENOL
058	1	4-NITROPHENOL
059	1	2,4-DINITROPHENOL
060	1	2-METHYL-4,6-DINITROPHENOL
064	1	PENTACHLOROPHENOL
530	1	2,3,6-TRICHLOROPHENOL
531	1	2,4,5-TRICHLOROPHENOL
943	2	BENZOIC ACID
944	2	P-CRESOL
945	2	3,5-DIBROMO-4-HYDROXYBENZONITR
946	2	2,6-DICHLOROPHENOL
947	2	HEXANOIC ACID
948	2	2,3,4,6-TETRACHLOROPHENOL

Table 4.6: List of Analytes, Matrices, Fractions, and Methods for the Screen Sampling of the Oil Reclamation/Re-Refining Industry

(1) Analysis Category	(2) Matrix	(3) Fraction	(4) Analysis Technique	(5) Method	(6) Modification
Organics	Water	Volatiles	GCMS	1624C	
B/N	GCMS	1625C			
Acid	GCMS	1625C			
	Sludge	Volatiles	GCMS	1624C	
		B/N	GCMS	1625C	
		Acid	GCMS	1625C	
		Diox/Furan	HRGCHRMS	8280M	High res. MS
Org/TCLP	----------------------same as for waters----------------------				
Metals	Water	Mercury	CVAA	245.5	
		Furnace	FURNAA		
			Sb	204.2	
			As	206.2	
			Se	270.2	
			Ag	272.2	
			Tl	279.2	
		ICP	ICP	200.7M + 42	Element screen
	Sludge	Mercury	CVAA	245.5M CLP	
		Furnace	FURNAA	3020	
			Sb	204.2M CLP	
			As	206.2M CLP	
			Se	270.2M CLP	
			Ag	272.2M CLP	
			Tl	279.2M CLP	
		ICP	ICP	200.7M + 42	Element screen + HCl if nec.
Met/TCLP	--------------same as for waters----------------------				

Table 4.6 (cont'd)

List of Analytes, Matrices, Fractions, and Methods for the Screen Sampling of the Oil Reclamation/Re-Refining Industry

(1) Analysis Category	(2) Matrix	(3) Fraction	(4) Analysis Technique	(5) Method	(6) Modification
Conventional	Water	Ammonia	Electrode	350.3	
		BOD5	Probe	405.1	
		Chloride	Ion Chrom.	300.0	
		Chlorine	Color.		Field test
		COD	Color.	410.4M	Saline
		Cyanide	Distill.	335.2	
		Fluoride	SPADNS	340.1	
		Nitrate/ nitrite	Ion Chrom.	300.0	
		pH (field)	Paper	--	
		(lab)	Electrode	150.1	
		Oil & Gr.	Grav.	413.1	
		Residue	Grav.-TDS	160.1	
			-TSS	160.2	
			-Tot.	160.3	
		Specific Conduct.	Wheatstone Bridge	120.1	
		Sulfide	Titr.	376.2	
		TOC	Combust.	415.1	
		TVO	TOC	415.1M	Purge & Trap
	Sludge	Ammonia	Electrode	350.3	
		BOD5	Probe	405.1	
		Chloride	Ion Chrom.	300.0	
		COD	Color.	410.4M	Saline
		Cyanide	Distill.	335.2	
		Fluoride	SPADNS	340.1	
		Nitrate/ Nitrite	Ion Chrom.	300.0	
		pH (field)	Paper	--	
		(lab)	Electrode	150.1	
		Oil & Gr.	Grav.	413.1	
		Oil & Gr.	Retort	--	
		Residue	Grav.-Tot.	160.3	
		Sulfide	Color.	376.2	
		TOC	Combust.	9060	
		TVO	TOC	415.1M	Purge & Trap
RCRA	Sludge	Ignit.		1010	
		Corrosiv.		1110	
		React.		SW-846	

Table 4.6 (cont'd)

List of Analytes, Matrices, Fractions, and Methods for the Screen Sampling of the Oil Reclamation/Re-Refining Industry

Notes:

(1) Analysis category - general category into which analytes can be classified.

- Organics - carbon based chemical compounds. The list of these compounds can be found on the ITD/RCRA List of Analytes.
- Organics/TCLP - organic compounds leached from sludge and sediment using the RCRA Toxicity Characteristic Leaching Procedure.
- Metals - elements found on the ITD/RCRA List of Analytes.
- Metals/TCLP - metals leached from sludge and sediment using the TCLP.
- Conventional - conventional wastewater chemistry analytes.
- Hazardous waste characteristics - RCRA analytes which determine if a waste is hazardous. The TCLP has been proposed to replace the current EP Toxicity procedure.

(2) Matrix - the nature of the sample.

- Water - produced water, runoff water, or other sample which is nearly all water.
- Sludge - distillation bottoms, spent clays, filter cakes, or other sample which contains a significant quantity of solids (normally greater than 1 percent).

(3) Fraction - a means of further categorizing the sample for purposes of analysis.

- Volatile - volatile organic compounds analyzed by GCMS.
- B/N - base/neutral organic compounds analyzed by GCMS.
- Acid - organic acids analyzed by GCMS.

Table 4.6 (cont'd)

List of Analytes, Matrices, Fractions, and Methods for the Screen Sampling of the Oil Reclamation/Re-Refining Industry

(3) Fraction: (Continued)

- Diox/Furan - chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans.
- TVOC - total volatile organic carbon.
- Furnace - metals analyzed by furnace atomic absorption spectrometry.
- ICP - metals analyzed by inductively coupled spectrometry.
- BOD5 - biochemical oxygen demand.
- COD - chemical oxygen demand.
- Oil and Gr. - oil and grease.
- Specific conduct. - specific conductivity.
- TOC - total organic carbon.
- Ignit. - hazardous waste characteristic of ignitability.
- Corrosiv. - hazardous waste characteristic of corrosivity.
- React. - hazardous waste characteristic of reactivity.

(4) Analysis technique

- GCEC - gas chromatography combined with an electron capture detector.
- GCFPD - gas chromatography combined with a flame photometric detector.
- GCMS - gas chromatography combined with a mass spectrometer detector.
- HRGCLRMS - high resolution gas chromatography combined with low resolution mass spectrometry.

Table 4.6

List of Analytes, Matrices, Fractions, and Methods for the Screen Sampling of the Oil Reclamation/Re-Refining Industry

(4) Analysis Techniques: (Continued)

- HRGCHRMS - high resolution gas chromatography combined with high resolution mass spectrometry.
- TOC - total organic carbon analyzer.
- CVAS - cold vapor atomic absorption spectrometry.
- FURNAA - furnace atomic absorption spectrometry.
- Ion Chrom. - ion chromatography.
- Color. - colorimetric
- Titr. - titrimetric
- Distill. - distillation.
- SPADNS - distillation followed by calorimetric.
- Grav. - gravimetric.
- TDS - total dissolved solids.
- TSS - total suspended solids.
- Tot. - total solids.

(5) Method - the EPA method number.

Water methods are three-digit numbers (some include a decimal). ITD methods are 1618, 1624C, and 1625C. Office of Solid Waste SW-846 methods are all other four-digit numbers.

Table 4.6 (cont'd)

List of Analytes, Matrices, Fractions, and Methods for the Screen Sampling of the Oil Reclamation/Re-Refining Industry

Notes: (Continued)

(6) Gives a modifiction of the method.

- Cl4 to Cl8 - Samples were screened for all tetra- through octa-isomers of chlorinated dibenzo-p-dioxin and dibenzofuran.
- High res. MS - high resolution mass spectrometer was used in place of low resolution instrument to gain specificity.
- + 42 element screen - search of a specific ICP wavelength for 42 metals in addition to the 27 determined by calibration and search.
- CLP - method modified for application to solids by the Superfund Contract Laboratory Program.
- Purge & Trap - volatiles are purged from water or sludge.
- + HCl if nec. - hydrochloric acid added to aid in digestion of organic sludges if necessary.
- Field test - test performed at the site.
- Saline - Hach method 8000.

Table 4.7: Characterization of Oil Reclamation/Re-Refining Industry Screen Sampling Program Summary

EPA Sample Control Center Number	Episode No.	Facility Name	Sample Location	Sample Day	Collection Method	Sample Type*
15492	1139	A	Influent	1	24 hr Comp.	L
15493	1139	A	Final Effluent	1	24 hr Comp.	L
15494	1139	A	Filter Cake	1	24 hr Comp.	S
15495	1139	A	Distillation Bottoms	1	Grab	S
15496	1139	A	Spent Clay	1	Grab	S
15497	1139	A	Spent Clay	2	Grab	S
15498	1139	A	Influent	2	Grab	L
15499	1139	A	Final Effluent	2	Grab	L
15500	1139	A	Filter Cake	2	Grab	S
15501	1139	A	Duplicate Effluent	2	Grab	L
15502	1139	A	Filter Cake	3	Grab	S
15503	1139	A	Spent Clay	3	Grab	S
15504	1139	A	Filter Cake	3	Grab	S
15505	1140	B	Final Effluent	1	24 hr Comp.	L
15506	1140	B	Influent	1	24 hr Comp.	L
15507	1140	B	DAF Sludge	1	24 hr Comp.	S
15508	1140	B	Distillation Bottoms	1	Grab	S
15509	1140	B	Spent Clay	1	Grab	S
15510	1140	B	Final Effluent	2	24 hr Comp.	L
15511	1140	B	Influent	2	24 hr Comp.	L
15512	1140	B	DAF Sludge	2	Grab	S
15513	1140	B	Duplicate Effluent	2	24 hr Comp.	L
15514	1140	B	Distillation Bottoms	2	Grab	S
15515	1140	B	Spent Clay	2	Grab	S
15635	1163	C	Influent	1	24 hr Comp.	L
15636	1163	C	DAF Effluent	1	24 hr Comp.	L
15637	1163	C	Filter Effluent	1	24 hr Comp.	L
15638	1163	C	Stripper Effluent	1	24 hr Comp.	L
15639	1163	C	Final Effluent	1	24 hr Comp.	L
15640	1163	C	Duplicate Effluent	1	24 hr Comp.	L
15641	1163	C	DAF Sludge	1	Grab	S
15642	1163	C	Distillation Bottoms	1	Grab	S
15643	1163	C	Spent Carbon	1	Grab	S
15644	1163	C	Influent	2	24 hr Comp.	L
15645	1163	C	DAF Effluent	2	24 hr Comp.	L
15646	1163	C	Filter Effluent	2	24 hr Comp.	L
15647	1163	C	Stripper Effluent	2	24 hr Comp.	L
15648	1163	C	Final Effluent	2	24 hr Comp.	L

* L - Liquid Waste Stream
S - Solid Waste Stream

Table 4.7 (cont'd)

Characterization of Oil Reclamation/Re-Refining Industry Screen Sampling Program Summary

EPA Sample Control Center Number	Episode No.	Facility Name	Sample Location	Sample Day	Collection Method	Sample Type*
15649	1163	C	Duplicate Effluent	2	24 hr Comp.	L
15650	1163	C	DAF Sludge	2	Grab	S
15651	1163	C	Distillation Bottoms	2	Grab	S
15652	1163	C	Spent Carbon	2	Grab	S
15653	1163	C	DAF Sludge	3	Grab	S
15654	1163	C	Spent Carbon	3	Grab	S
15657	1164	D	Final Effluent	1	24 hr Comp.	L
15659	1164	D	Scrubber Effluent	2	24 hr Comp.	L
15660	1164	D	Distillation Bottoms	1	Grab	S
15665	1164	D	Distillation Bottoms	2	Grab	S

* L - Liquid Waste Stream
S - Solid Waste Stream

Appendix A

ANALYTICAL DATA

TABLE A-1

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
FACILITY A - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
Conventionals					
BOD	680 mg/l	<1 mg/l	640 mg/l	480 mg/l	500 mg/l
TSS	280 mg/l	30 mg/l	92 mg/l	76 mg/l	64 mg/l
Oil & Grease	820 mg/l	15 mg/l	980 mg/l	18 mg/l	15 mg/l
pH	6.21	7.10	6.49	7.02	7.05
Non-Conventionals					
Conductivity	5500 umhos/cm	3000 umhos/cm	4400 umhos/cm	3500 umhos/cm	3800 umhos/cm
TDS	23800 mg/l	1290 mg/l	7470 mg/l	2080 mg/l	2240 mg/l
Cyanide	0.60 mg/l	0.04 mg/l	0.31 mg/l	0.04 mg/l	0.04 mg/l
Sulfide	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l
TVO	79 mg/l	59 mg/l	150 mg/l	0.58 mg/l	30 mg/l
COD	150 mg/l	3600 mg/l	18000 mg/l	4600 mg/l	3100 mg/l
TOC	3400 mg/l	800 mg/l	3200 mg/l	780 mg/l	810 mg/l
Ammonia	36 mg/l	7.2 mg/l	38 mg/l	9.6 mg/l	5.2 mg/l
Nitrite+Nitrate	4.0 mg/l	0.5 mg/l	70 mg/l	9.6 mg/l	5.2 mg/l
Fluoride	3.4 mg/l	1.8 mg/l	1.0 mg/l	1.7 mg/l	13 mg/l
Phenolics	227 mg/l	2.50 mg/l	122 mg/l	163 mg/l	17.7 mg/l
Chloride	2840 mg/l	195 mg/l	3970 mg/l	1020 mg/l	170 mg/l

TABLE A-2

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
FACILITY B - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
Conventionals					
BOD	3500 mg/l	<1 mg/l	<1 mg/l	<1 mg/l	<1 mg/l
TSS	168 mg/l	52 mg/l	144 mg/l	248 mg/l	505 mg/l
Oil & Grease	578 mg/l	246 mg/l	352 mg/l	232 mg/l	578 mg/l
pH	6.00	8.32	6.50	8.43	8.52
Non-Conventionals					
Conductivity	2500 umhos/cm	3000 umhos/cm	2000 umhos/cm	3000 umhos/cm	3000 umhos/cm
TDS	3270 mg/l	2220 mg/l	1420 mg/l	2570 mg/l	1700 mg/l
Cyanide	0.09 mg/l	0.07 mg/l	0.11 mg/l	0.14 mg/l	0.14 mg/l
Sulfide	<0.1 mg/l	<0.1 mg/l	1.8 mg/l	<0.1 mg/l	<0.1 mg/l
TVO	74 mg/l	57 mg/l	67 mg/l	54 mg/l	76 mg/l
COD	14000 mg/l	12000 mg/l	1700 mg/l	12000 mg/l	9000 mg/l
TOC	1900 mg/l	1700 mg/l	1000 mg/l	1500 mg/l	1700 mg/l
Ammonia	9.2 mg/l	66 mg/l	72 mg/l	86 mg/l	99 mg/l
Nitrite+Nitrate	1.6 mg/l	0.9 mg/l	1.2 mg/l	1.7 mg/l	1.9 mg/l
Fluoride	1.4 mg/l	1.8 mg/l	1.2 mg/l	1.8 mg/l	1.5 mg/l
Phenolics	150 mg/l	168 mg/l	159 mg/l	183 mg/l	212 mg/l
Chloride	4720 mg/l	630 mg/l	290 mg/l	550 mg/l	620 mg/l

TABLE A-3

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 1					
	INFLUENT	DAF EFFLUENT	FILTER EFFLUENT	STRIPPER EFFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
Conventionals						
BOD	7500 mg/l	9800 mg/l	10200 mg/l	9300 mg/l	8700 mg/l	7800 mg/l
TSS	132 mg/l	220 mg/l	156 mg/l	92 mg/l	56 mg/l	74 mg/l
Oil & Grease	142 mg/l	75 mg/l	68 mg/l	60 mg/l	8 mg/l	5 mg/l
pH	9.55	8.35	8.37	8.54	8.40	8.37
Non-Conventionals						
Conductivity	12000 umhos/cm	12000 umhos/cm	12000 umhos/cm	14000 umhos/cm	13000 umhos/cm	14000 umhos/cm
TDS	4900 mg/l	9600 mg/l	11000 mg/l	10000 mg/l	22000 mg/l	23000 mg/l
Cyanide	0.14 mg/l	0.10 mg/l	0.12 mg/l	0.12 mg/l	<0.01 mg/l	0.01 mg/l
Sulfide	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l
TVO	280 mg/l	240 mg/l	350 mg/l	220 mg/l	190 mg/l	170 mg/l
COD	24000 mg/l	30500 mg/l	29500 mg/l	24000 mg/l	18000 mg/l	19500 mg/l
TOC	7780 mg/l	7660 mg/l	7500 mg/l	7340 mg/l	5880 mg/l	5860 mg/l
Ammonia	46 mg/l	46 mg/l	46 mg/l	46 mg/l	37 mg/l	37 mg/l
Nitrite+Nitrate	6.2 mg/l	3.2 mg/l	5.0 mg/l	3.2 mg/l	<1 mg/l	<1 mg/l
Fluoride	170 mg/l	68 mg/l	170 mg/l	180 mg/l	180 mg/l	190 mg/l
Phenolics	62 mg/l	62 mg/l	55 mg/l	60 mg/l	1.4 mg/l	1.5 mg/l
Chloride	1500 mg/l	2240 mg/l	2290 mg/l	2200 mg/l	2300 mg/l	2240 mg/l

TABLE A-3 (Continued)

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 2					
	INFLUENT	DAF EFFLUENT	FILTER EFFLUENT	STRIPPER EFFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
Conventionals						
BOD	11100 mg/l	12300 mg/l	13500 mg/l	9300 mg/l	7200 mg/l	8400 mg/l
TSS	76 mg/l	116 mg/l	190 mg/l	110 mg/l	100 mg/l	118 mg/l
Oil & Grease	147 mg/l	108 mg/l	263 mg/l	108 mg/l	10 mg/l	11 mg/l
pH	9.76	8.82	8.79	8.89	8.63	8.63
Non-Conventionals						
Conductivity	17000 umhos/cm	18000 umhos/cm	18000 umhos/cm	18000 umhos/cm	17000 umhos/cm	18000 umhos/cm
TDS	17000 mg/l	13000 mg/l	15000 mg/l	14000 mg/l	17000 mg/l	2100 mg/l
LOD						
Cyanide	0.16 mg/l	0.13 mg/l	0.12 mg/l	0.11 mg/l	0.03 mg/l	0.04 mg/l
Sulfide	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l	<0.1 mg/l
TVO	440 mg/l	400 mg/l	390 mg/l	120 mg/l	330 mg/l	250 mg/l
COD	26000 mg/l	35500 mg/l	24000 mg/l	22500 mg/l	21000 mg/l	21000 mg/l
TOC	8180 mg/l	8050 mg/l	7950 mg/l	7750 mg/l	6620 mg/l	6640 mg/l
Ammonia	37 mg/l	42 mg/l	46 mg/l	31 mg/l	29 mg/l	31 mg/l
Nitrite+Nitrate	6.4 mg/l	5.6 mg/l	3.4 mg/l	5.4 mg/l	<1 mg/l	<1 mg/l
Fluoride	180 mg/l	200 mg/l	200 mg/l	210 mg/l	220 mg/l	210 mg/l
Phenolics	62 mg/l	64 mg/l	64 mg/l	59 mg/l	1.5 mg/l	1.5 mg/l
Chloride	3350 mg/l	4380 mg/l	4600 mg/l	3400 mg/l	3580 mg/l	3480 mg/l

TABLE A-4

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
FACILITY D - WATER SAMPLES

	SAMPLE DAY 1 FINAL EFFLUENT		SAMPLE DAY 2 SCRUBBER EFFLUENT	
Conventionals				
BOD	15000	mg/l	2400	mg/l
TSS	18	mg/l	54	mg/l
Oil & Grease	243	mg/l	10	mg/l
pH	2.51		7.61	
Non-Conventionals				
Conductivity	10500	umhos/cm	4500	umhos/cm
TDS	7200	mg/l	2500	mg/l
Cyanide	0.66	mg/l	<0.01	mg/l
Sulfide	<1.0	mg/l	18	mg/l
TVO	75000	mg/l	134	mg/l
COD	48000	mg/l	175	mg/l
TOC	11400	mg/l	1440	mg/l
Ammonia	115	mg/l	<0.1	mg/l
Nitrite+Nitrate	53	mg/l	1.2	mg/l
Fluoride	88	mg/l	<1.0	mg/l
Phenolics	3.51	mg/l	0.26	mg/l
Chloride	1880	mg/l	58	mg/l

TABLE A-5

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
Conventionals					
BOD	<2 mg/kg	<2 mg/kg	491000 mg/kg	26400 mg/kg	415000 mg/kg
Oil & Grease	650000 mg/kg	640000 mg/kg	69700 mg/kg	1740 mg/kg	58800 mg/kg
pH			8.51	9.01	7.94
Non-Conventionals					
LOD	50.5 %	37.8 %	96.7 %	36.7 %	96.6 %
Cyanide	<2 mg/kg	<2 mg/kg	70 mg/kg	<2 mg/kg	35 mg/kg
Sulfide	2500 mg/kg	8600 mg/kg	2500 mg/kg	<0.1 mg/kg	2.9 mg/kg
TVO	2700 mg/kg	1400 mg/kg	1700 mg/kg	380 mg/kg	1700 mg/kg
COD	23000 mg/kg	33000 mg/kg	1000000 mg/kg	51700 mg/kg	1000000 mg/kg
TOC	120000 mg/kg	180000 mg/kg	306000 mg/kg	8660 mg/kg	176000 mg/kg
Ammonia	340 mg/kg	305 mg/kg	1900 mg/kg	95 mg/kg	1890 mg/kg
Nitrite+Nitrate	3.2 mg/kg	2.2 mg/kg	1680 mg/kg	66.8 mg/kg	1520 mg/kg
Fluoride	190 mg/kg	140 mg/kg	4700 mg/kg	5470 mg/kg	95900 mg/kg
Phenolics	3.73 mg/kg	945 mg/kg	1800 mg/kg	97 mg/kg	1800 mg/kg
Chloride	1700 mg/kg	2380 mg/kg	84200 mg/kg	59600 mg/kg	559000 mg/kg

TABLE A-6

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
Conventionals					
BOD	2600 mg/kg	1600 mg/kg	3600 mg/kg	2000 mg/kg	840 mg/kg
Oil & Grease	580000 mg/kg	580000 mg/kg	550000 mg/kg	460000 mg/kg	540000 mg/kg
pH	8.33	4.95	9.17		
Non-Conventionals					
LOD	3.7 %	7.0 %	5.4 %	3.5 %	5.7 %
Cyanide	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg
Sulfide	<0.06 mg/kg	<0.06 mg/kg	<0.06 mg/kg	<0.06 mg/kg	<0.06 mg/kg
TVO	4.7 mg/kg	12 mg/kg	4.3 mg/kg	0.70 mg/kg	0.76 mg/kg
COD	15000 mg/kg	15000 mg/kg	94080 mg/kg	470 mg/kg	1700 mg/kg
TOC	46000 mg/kg	99000 mg/kg	25000 mg/kg	>210000 mg/kg	19000 mg/kg
Ammonia	20 mg/kg	30 mg/kg	27 mg/kg	20 mg/kg	54 mg/kg
Nitrite+Nitrate	8.2 mg/kg	2.7 mg/kg	28 mg/kg	<0.6 mg/kg	<0.6 mg/kg
Fluoride	1000 mg/kg	220 mg/kg	580 mg/kg	240 mg/kg	230 mg/kg
Phenolics	75.8 mg/kg	39.1 mg/kg	122 mg/kg	291 mg/kg	284 mg/kg
Chloride	639 mg/kg	2230 mg/kg	1120 mg/kg	94 mg/kg	265 mg/kg

TABLE A-7

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
Conventionals			
BOD	23300 mg/kg	2470 mg/kg	2500 mg/kg
Oil & Grease	788 mg/kg	1840 mg/kg	2120 mg/kg
pH	8.96	10.24	9.51
Non-Conventionals			
LOD	29.7 %	29.2 %	29.1 %
Cyanide	10 mg/kg	8.8 mg/kg	16 mg/kg
Sulfide	<0.1 mg/kg	<0.1 mg/kg	<0.1 mg/kg
TVO	5300 mg/kg	75 mg/kg	30 mg/kg
COD	38500 mg/kg	52100 mg/kg	57800 mg/kg
TOC	31700 mg/kg	103000 mg/kg	43200 mg/kg
Ammonia	97 mg/kg	79 mg/kg	102 mg/kg
Nitrite+Nitrate	<14 mg/kg	<14 mg/kg	<14 mg/kg
Fluoride	2660 mg/kg	2810 mg/kg	931 mg/kg
Phenolics	2100 mg/kg	130 mg/kg	700 mg/kg
Chloride	10300 mg/kg	3520 mg/kg	10600 mg/kg

TABLE A-8

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
Conventionals							
BOD	1400 mg/kg	1300 mg/kg	<1 mg/kg	25300 mg/kg	38600 mg/kg	1200 mg/kg	900 mg/kg
Oil & Grease	1000000 mg/kg	1000000 mg/kg	1000000 mg/kg	1000000 mg/kg	1000000 mg/kg	12200 mg/kg	11700 mg/kg
pH				CANCEL	CANCEL	6.96	7.00
Non-Conventionals							
LOD	0.4 %	0.4 %	<0.1 %	0.3 %	1.5 %	<1.0 %	<1.0 %
Cyanide	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1 mg/kg	<1.0 mg/kg	<1.0 mg/kg
Sulfide	<0.06 mg/kg	<0.06 mg/kg	<0.06 mg/kg	<3 mg/kg	<0.1 mg/kg	<0.06 mg/kg	<0.06 mg/kg
TVO	110 mg/kg	110 mg/kg	5.7 mg/kg	100 mg/kg	5.3 mg/kg	2580 mg/kg	3280 mg/kg
COD	4900 mg/kg	24000 mg/kg	600 mg/kg	24000 mg/kg	69200 mg/kg	4180 mg/kg	18200 mg/kg
TOC	>210000 mg/kg	99000 mg/kg	110000 mg/kg	64500 mg/kg	121000 mg/kg	41900 mg/kg	151000 mg/kg
Ammonia	21 mg/kg	13 mg/kg	36 mg/kg	5.1 mg/kg	7.1 mg/kg	9.4 mg/kg	10.0 mg/kg
Nitrite+Nitrate	1.7 mg/kg	<0.6 mg/kg	2.8 mg/kg	<10 mg/kg	<10 mg/kg	<0.6 mg/kg	<0.6 mg/kg
Fluoride	110 mg/kg	100 mg/kg	270 mg/kg	64.2 mg/kg	3700 mg/kg	<1.0 mg/kg	2.1 mg/kg
Phenolics	139 mg/kg	590 mg/kg	3.33 mg/kg	26 mg/kg	14 mg/kg	8.9 mg/kg	1.4 mg/kg
Chloride	218 mg/kg	442 mg/kg	330 mg/kg	25000 mg/kg	40300 mg/kg	3.1 mg/kg	8.9 mg/kg

TABLE A-9

CONVENTIONAL/NON-CONVENTIONAL PARAMETERS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
Conventionals				
BOD	22000 mg/kg	19000 mg/kg	16000 mg/kg	6600 mg/kg
Oil & Grease	140000 mg/kg	160000 mg/kg	270000 mg/kg	650000 mg/kg
pH	8.50	8.77	7.40	7.38
Non-Conventionals				
LOD	59.8 %	61.2 %	48.8 %	52.7 %
Cyanide	10.90 mg/kg	9.02 mg/kg	6.84 mg/kg	11.60 mg/kg
Sulfide	<0.15 mg/kg	<0.15 mg/kg	<0.12 mg/kg	<0.13 mg/kg
TVO	310 mg/kg	1500 mg/kg	110 mg/kg	160 mg/kg
COD	29000 mg/kg	52000 mg/kg	83000 mg/kg	14000 mg/kg
TOC	80000 mg/kg	57000 mg/kg	100000 mg/kg	140000 mg/kg
Ammonia	147 mg/kg	113 mg/kg	76 mg/kg	82 mg/kg
Nitrite+Nitrate	4.5 mg/kg	113 mg/kg	76 mg/kg	82 mg/kg
Fluoride	70 mg/kg	<3 mg/kg	60 mg/kg	21 mg/kg
Phenolics	1130 mg/kg	1340 mg/kg	1010 mg/kg	1870 mg/kg
Chloride	629 mg/kg	2050 mg/kg	1560 mg/kg	317 mg/kg

TABLE A-10

ORGANICS RESULTS
FOR
FACILITY A - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	INFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	DUPLICATE EFFLUENT (ug/l)
Volatiles					

BENZENE				22	21
1,2-DICHLOROETHANE					87
1,1,1-TRICHLOROETHANE			573	92	89
1,1-DICHLOROETHANE					197
1,1-DICHLOROETHENE				17	16
ETHYLBENZENE			642		
TOLUENE	4321		5054	67	69
2-BUTANONE (MEK)	8264	1549	5831	675	491
P-DIOXANE		6219	38262		8111
4-METHYL-2-PENTANONE		1343	970	183	1160
Semi-Volatiles					

2,4-DIMETHYLPHENOL	9328	109			
NAPHTHALENE	2601		3522		
PHENOL	257851	3933	127501	16574	17030
N-DODECANE (N-C12)	9325		18038		773
DIPHENYL ETHER	7338		9833		
ALPHA-TERPINEOL	2061				
BIPHENYL	2779		3783		
N-DECANE (N-C10)	8966		5948		
N-TETRADECANE (N-C14)	16524		12619		
N-HEXADECANE (N-C16)	12174		9667		132
N-OCTADECANE (N-C18)	1381		1242		
N-EICOSANE (N-C20)	1239		1507		
O-CRESOL	2517	10			133
2-METHYLNAPHTHALENE	3167		3990		
BENZOIC ACID				6224	
P-CRESOL	14642	114			
HEXANOIC ACID				2937	

TABLE A-11

ORGANICS RESULTS
FOR
FACILITY B - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	INFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	DUPLICATE EFFLUENT (ug/l)
Volatiles					

BENZENE			1104	777	786
1,1,1-TRICHLOROETHANE			3192	2643	2272
1,1-DICHLOROETHANE	5128		3547	2574	2528
ETHYLBENZENE				547	292
TOLUENE			2770	2702	2101
TRICHLOROETHENE			938	711	659
2-BUTANONE (MEK)			15692	12706	15583
2-HEXANONE					897
4-METHYL-2-PENTANONE	5313		4051	4413	3769
Semi-Volatiles					

2,4-DIMETHYLPHENOL		4047	3496	4339	4662
NAPHTHALENE			1530	1708	1363
PHENOL		278158	184403	290021	308742
N-DODECANE (N-C12)		1415	3758	4965	4039
ALPHA-TERPINEOL				1018	
N-DECANE (N-C10)		1724	3350	2549	1817
N-TETRADECANE (N-C14)			2164	1963	1904
N-HEXADECANE (N-C16)			2445	2650	2122
N-OCTADECANE (N-C18)					1231
N-EICOSANE (N-C20)			1849	1559	1246
O-CRESOL		6329			
2-METHYLNAPHTHALENE			1395	1651	1754
TRIPROPYLENEGLYCOL METHYL ETHE		5539		4267	6179
P-CRESOL		5814	5469	6414	6307
HEXANOIC ACID		4240	5772	13491	14756

TABLE A-12

ORGANICS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 1					
	INFLUENT (ug/l)	DAF EFFLUENT (ug/l)	FILTER EFFLUENT (ug/l)	STRIPPER EFFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	DUPLICATE EFFLUENT (ug/l)
Volatiles						
BENZENE	13052	11519	8384			
CARBON TETRACHLORIDE	7438	5287				
1,1,1-TRICHLOROETHANE	40090	27249	20744			
1,1-DICHLOROETHANE	11489	10245	7761			
TOLUENE	25439	21763	16476			
2-BUTANONE (MEK)	69620	70086	61138	55710	664	1127
P-DIOXANE	50994	43516	39329	38212	638	116
ETHYL CYANIDE					2591	
2-HEXANONE		2883		5560		
4-METHYL-2-PENTANONE	8128	7974	7320	10036		
Semi-Volatiles						
4-CHLORO-3-METHYLPHENOL	1011					
2,4-DIMETHYLPHENOL	4063	3453	3853	4287		
PHENOL	35581	34919	34516	35646		
N-DECANE (N-C10)	2344					
BENZYL ALCOHOL		1190				
O-CRESOL	5022	6467	5191	5752		
N,N-DIMETHYLFORMAMIDE				2286		
PYRIDINE				1856		
BENZOIC ACID	40197	38546	38532	33559		
P-CRESOL	16091	16946	16043	16834		
HEXANOIC ACID	37812	3598	35388	39345		

TABLE A-12 (Continued)

ORGANICS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 2					
	INFLUENT (ug/l)	DAF EFFLUENT (ug/l)	FILTER EFFLUENT (ug/l)	STRIPPER EFFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	DUPLICATE EFFLUENT (ug/l)
Volatiles						

ACROLEIN	58400		12078			
BENZENE	13116	10016	8750			
CHLOROBENZENE	58					
1,2-DICHLOROETHANE	551					
1,1,1-TRICHLOROETHANE	43221	41540	36430			
1,1-DICHLOROETHANE	11704	8407	7244			
CHLOROFORM	168					
1,1-DICHLOROETHENE	351					
ETHYLBENZENE	1670					
TETRACHLOROETHENE	3292					
TOLUENE	25792	19205	16129			
TRICHLOROETHENE	220					
2-BUTANONE (MEK)	62734	61393	57683			
DIETHYL ETHER	374					
P-DIOXANE					88987	59712
2-HEXANONE	3886					
4-METHYL-2-PENTANONE	53248	26900	16379	3197		
TRICHLOROFLUOROMETHANE	803					
Semi-Volatiles						

2,4-DIMETHYLPHENOL	3685	4003	3837	4429		
BIS (2-CHLOROISOPROPYL) ETHER					40	45
PHENOL	34936	35013	35159	37183	29	14
N-DODECANE (N-C12)		1623				
BENZYL ALCOHOL	1361	1298		1209		

TABLE A-12 (Continued)

ORGANICS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 2					
	INFLUENT (ug/l)	DAF EFFLUENT (ug/l)	FILTER EFFLUENT (ug/l)	STRIPPER EFFLUENT (ug/l)	FINAL EFFLUENT (ug/l)	DUPLICATE EFFLUENT (ug/l)
Semi-Volatiles						

O-CRESOL	5135	6369	40255	5120		
N,N-DIMETHYLFORMAMIDE	1215	1129	1555	1424		
BENZOIC ACID	32274	41678	29142	36738	23763	
P-CRESOL	15733	19629	15132	15177		
HEXANOIC ACID	43413	48260	45201	40877	3506	

TABLE A-13

ORGANICS RESULTS
FOR
FACILITY D - WATER SAMPLES

	SAMPLE DAY 1	
	FINAL EFFLUENT (ug/l)	SCRUBBER EFFLUENT (ug/l)
Volatiles		
ACROLEIN	1138	
BENZENE	11149	
CARBON TETRACHLORIDE	1444	
1,2-DICHLOROETHANE	315	
1,1,1-TRICHLOROETHANE	8793	
1,1-DICHLOROETHANE	187	
CHLOROFORM	4147	
1,2-DICHLOROPROPANE	137	
ETHYLBENZENE	2021	
TETRACHLOROETHENE	1750	
TOLUENE	20232	
2-BUTANONE (MEK)	35510	
P-DIOXANE	93346	
ETHYL CYANIDE	3963	
2-HEXANONE	500	
METHYL METHACRYLATE	16552	
4-METHYL-2-PENTANONE	5345	
TRICHLOROFLUOROMETHANE	278	
VINYL ACETATE	5118	
Semi-Volatiles		
PHENOL		64
N-DECANE (N-C10)	2365	
N-HEXADECANE (N-C16)		14
BENZYL ALCOHOL	1993	
PYRIDINE	2399	
BENZOIC ACID	39401	

TABLE A-14

ORGANICS RESULTS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 3 (ug/kg)
Volatiles					
BENZENE	30614	32631	527938		430050
1,1,1-TRICHLOROETHANE	120481	119427	3236563	1102167	1582750
1,1-DICHLOROETHANE	51242	56441	333750		291700
ETHYLBENZENE	90619	98897	625125		427350
TETRACHLOROETHENE	50536	47610	1452625		1017150
TOLUENE	264605	287810	2613063	547278	1978700
TRICHLOROETHENE	55401	61607			
2-BUTANONE (MEK)			2042938	1882222	1877800
4-METHYL-2-PENTANONE			37835	555944	19912
Semi-Volatiles					
2,4-DIMETHYLPHENOL		54934		234100	121467
PHENOL		244983	374532	451915	395031
O-CRESOL		36197	775112	208648	237221
2-METHYLNAPHTHALENE	428393	518141	252779		74747
1-METHYLPHENANTHRENE	119257	203217			
BENZOIC ACID				80759	323042
P-CRESOL			539581	410374	404693
HEXANOIC ACID			845988	655444	672025

TABLE A-15

ORGANICS RESULTS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 3 (ug/kg)	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)
Volatiles					
2-BUTANONE (MEK)			410		
P-DIOXANE			3527		
4-METHYL-2-PENTANONE			630		
Semi-Volatiles					
2,4-DIMETHYLPHENOL	5960		18572		
PHENOL	35376	5925	42893	163357	148563
2-METHYLNAPHTHALENE		6951		8019	
1-METHYLPHENANTHRENE	83460		38541	109450	97713
P-CRESOL				4283	

TABLE A-16

ORGANICS RESULTS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 3 (ug/kg)
Volatiles			
ACROLEIN	123353	88221	55930
BENZENE	27822	317250	
1,2-DICHLOROETHANE	15200		
1,1,1-TRICHLOROETHANE	216750	211964	121882
1,1-DICHLOROETHANE	96538	113838	79879
2-BUTANONE (MEK)	181172	6576571	530846
P-DIOXANE	427136		
2-HEXANONE	6185		
4-METHYL-2-PENTANONE	111610	81686	74893
Semi-Volatiles			
2,4-DIMETHYLPHENOL	327990	18020	11753
PHENOL	9720955	1301167	911238
BENZYL ALCOHOL		17949	7269
O-CRESOL	511864	35248	17208
N,N-DIMETHYLFORMAMIDE	16628	17729	19603
PYRIDINE	39176	18438	10042
TRIPROPYLENEGLYCOL METHYL ETHE		2001735	979355
P-CRESOL	1207091	87045	41068

TABLE A-17

ORGANICS RESULTS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)
Volatiles							

ACROLEIN					7313		
BENZENE				239175			
ETHYLBENZENE					1279		
TOLUENE					1866		
2-BUTANONE (MEK)			13659	3093950		3311625	3056625
Semi-Volatiles							

PHENOL				41667			

TABLE A-18

ORGANICS RESULTS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1 (ug/kg)	SAMPLE DAY 2 (ug/kg)	SAMPLE DAY 3 (ug/kg)	
Volatiles				
BENZENE		812		
1,1,1-TRICHLOROETHANE		2641		
ETHYLBENZENE	35521	6777		
TETRACHLOROETHENE		2144		
TOLUENE	271473	33620	2694	
TRICHLOROETHENE	8871	2419		
2-BUTANONE (MEK)	199001			
P-DIOXANE		44529		
4-METHYL-2-PENTANONE			8827	
Semi-Volatiles				
2,4-DIMETHYLPHENOL	44501	92285		
PHENOL	16351	1020354		792536
2-METHYLNAPHTHALENE	53176	211729	280944	917764
1-METHYLPHENANTHRENE	25730	78023		114143

TABLE A-19

METALS RESULTS
FOR
FACILITY A - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP Screening Metals					
Al	DET	DET	DET	DET	DET
Sb	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND
B	DET	DET	DET	DET	DET
Cd	ND	ND	ND	ND	ND
Ca	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND
Cu	ND	ND	ND	ND	ND
Dy	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND
I	DET	ND	DET	DET	ND
Ir	ND	ND	ND	ND	ND
Fe	DET	ND	DET	ND	ND
La	ND	ND	ND	ND	ND
Li	ND	ND	ND	ND	ND
Lu	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND
Mg	DET	DET	DET	DET	DET
Mn	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND
Mo	DET	ND	ND	ND	ND
Nd	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND
Nb	ND	ND	ND	ND	ND
Os	ND	ND	ND	ND	ND

TABLE A-19 (Continued)

METALS RESULTS
FOR
FACILITY A - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP Screening Metals (Continued)					
Pd	ND	ND	ND	ND	ND
P	DET	DET	DET	DET	DET
Pt	ND	ND	ND	ND	ND
K	DET	DET	DET	ND	ND
Pr	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND
Si	DET	DET	DET	DET	DET
Ag	ND	ND	ND	ND	ND
Na	DET	DET	DET	DET	DET
Sr	ND	ND	ND	ND	ND
S	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND
Th	ND	ND	ND	ND	ND
Tm	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND
Ti	ND	ND	ND	ND	ND
W	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND
V	ND	ND	ND	ND	ND
Yb	ND	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND
Zn	DET	ND	DET	ND	ND
Zr	ND	ND	ND	ND	ND
ICP and AA Metals					
Al	1800	610	2500	69	51
Sb	340	<10	123	<10	<10

TABLE A-19 (Continued)

METALS RESULTS
FOR
FACILITY A - WATER SAMPLES

ICP and AA Metals (Continued)

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
As	26	<5	28	<5	<5
Ba	73	40	94	48	47
Be	1	<1	1	<1	<1
B	19000	5000	15000	4100	4100
Cd	9	5	10	<5	<5
Ca	130000	160000	140000	310000	310000
Cr	74	<3	79	<3	<3
Co	24	<4	30	9	8
Cu	140	13	190	12	8
Fe	15000	360	26000	250	220
Pb	280	<50	470	<50	<50
Mg	36000	18000	26000	19000	19000
Mn	570	150	500	300	300
Hg	<0.2	<0.2	<0.2	<0.2	<0.2
Mo	1100	150	410	33	30
Ni	68	<12	68	<12	<12
Se	<5	<5	<5	<5	<5
Ag	<1	<1	<1	<1	<1
Na	580000	150000	410000	150000	150000
Tl	<10	<10	<10	<10	<10
Sn	<65	<13	<65	<65	<65
Ti	50	10	50	50	50
V	6	8	7	6	<2
Y	<10	<10	<10	<10	<10
Zn	5600	34	4800	61	55

TABLE A-20

METALS RESULTS
FOR
FACILITY B - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
ICP Screening Metals	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
Al	DET	DET	DET	DET	DET
Sb	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND
Ba	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND
B	DET	DET	DET	DET	DET
Cd	ND	ND	ND	ND	ND
Ca	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	ND
Cr	DET	ND	DET	DET	DET
Co	ND	ND	ND	ND	ND
Cu	ND	ND	ND	ND	ND
Dy	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND
I	ND	ND	ND	ND	ND
Ir	ND	ND	ND	ND	ND
Fe	DET	DET	DET	DET	DET
La	ND	ND	ND	ND	ND
Li	ND	ND	ND	ND	ND
Lu	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND
Mg	DET	DET	DET	DET	DET
Mn	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND
Mo	ND	ND	ND	ND	ND
Nd	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND
Nb	ND	ND	ND	ND	ND
Os	ND	ND	ND	ND	ND
Pd	ND	ND	ND	ND	ND

TABLE A-20 (Continued)

METALS RESULTS
FOR
FACILITY B - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP Screening Metals (Continued)					
P	DET	DET	DET	DET	DET
Pt	ND	ND	ND	ND	ND
K	DET	DET	DET	DET	DET
Pr	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND
Si	DET	DET	DET	DET	DET
Ag	ND	ND	ND	ND	ND
Na	DET	DET	DET	DET	DET
Sr	ND	ND	ND	ND	ND
S	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND
Th	ND	ND	ND	ND	ND
Tm	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND
Ti	ND	ND	ND	ND	ND
W	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND
V	ND	ND	ND	ND	ND
Yb	ND	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND
Zn	DET	DET	DET	DET	DET
Zr	ND	ND	ND	ND	ND
ICP and AA Metals					
Al	1300	900	1300	1800	1300
Sb	10	<10	10	<10	14
As	24	24	15	25	27
Ba	250	89	140	170	160

TABLE A-20 (Continued)

METALS RESULTS
FOR
FACILITY B - WATER SAMPLES

	SAMPLE DAY 1		SAMPLE DAY 2		
	INFLUENT	FINAL EFFLUENT	INFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP and AA Metals (Continued)					
Be	1.0	<1.0	<1.0	<1.0	<1.0
B	13000	7800	11000	15000	14000
Cd	<5.0	<5.0	<5.0	<5.0	<5.0
Ca	53000	57000	64000	70000	73000
Cr	1200	760	1100	1000	1100
Co	<4.0	<4.0	<4.0	11	8
Cu	40	21	73	96	94
Fe	6200	9000	5300	11000	12000
Pb	580	150	360	530	480
Mg	21000	20000	20000	22000	24000
Mn	360	270	350	400	380
Hg	<0.2	<0.2	<0.2	<0.2	<0.2
Mo	52	18	27	41	41
Ni	180	140	140	160	150
Se	<5	<25	<25	<5	<5
Ag	<1	<1	<1	<1	<1
Na	130000	270000	100000	330000	380000
Tl	<10	<10	<10	<10	<10
Sn	<13	<13	<13	<13	<13
Ti	22	22	29	31	28
V	7	<2.0	6	10	7.0
Y	<10	<10	<10	<10	<10
Zn	1400	830	1100	1400	1300

TABLE A-21

METALS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 1					
	INFLUENT	DAF EFFLUENT	FILTER EFFLUENT	STRIPPER EFFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP Screening Metals						
Al	DET	DET	DET	DET	DET	DET
Sb	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND
Ba	DET	ND	ND	ND	ND	ND
Be	ND	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND	ND
B	DET	DET	DET	DET	DET	DET
Cd	ND	ND	ND	ND	ND	ND
Ca	DET	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND
Cu	DET	DET	ND	DET	DET	DET
Dy	ND	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND	ND
I	ND	ND	ND	ND	ND	ND
Ir	ND	ND	ND	ND	ND	ND
Fe	DET	DET	DET	DET	DET	DET
La	ND	ND	ND	ND	ND	ND
Li	DET	DET	DET	DET	DET	DET
Lu	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	DET	DET	ND
Mg	DET	DET	DET	DET	DET	DET
Mn	DET	DET	DET	DET	DET	DET
Hg	ND	ND	ND	ND	ND	ND
Mo	DET	DET	DET	DET	DET	DET
Nd	ND	ND	ND	ND	ND	ND
Ni	DET	ND	DET	DET	ND	ND
Nb	ND	ND	ND	ND	ND	ND
Os	DET	DET	ND	ND	DET	DET
Pd	ND	ND	ND	ND	ND	ND

TABLE A-21 (Continued)

METALS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 1					
		DAF	FILTER	STRIPPER	FINAL	DUPLICATE
	INFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT
ICP Screening Metals (Continued)						
P	DET	DET	DET	DET	DET	DET
Pt	ND	ND	ND	ND	ND	ND
K	DET	DET	DET	DET	DET	DET
Pr	ND	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND	ND
Se	ND	DET	DET	ND	DET	ND
Si	DET	DET	DET	DET	DET	DET
Ag	ND	ND	ND	ND	ND	ND
Na	DET	DET	DET	DET	DET	DET
Sr	DET	DET	DET	DET	DET	DET
S	DET	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND	ND
Th	DET	ND	ND	ND	ND	ND
Tm	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND
Ti	ND	ND	ND	ND	ND	ND
W	ND	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND	ND
V	ND	ND	ND	ND	ND	ND
Yb	ND	ND	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND	ND
Zn	DET	DET	DET	DET	DET	DET
Zr	ND	ND	ND	ND	ND	ND
ICP and AA Metals						
Al	1320	13200	8540	6400	2860	2290
Sb	<20	<20	<20	<20	<20	<20
As	<20	<20	<20	<20	<20	<20
Ba	311	<100	<100	<100	<100	<100

TABLE A-21 (Continued)

METALS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 1					
	INFLUENT	DAF EFFLUENT	FILTER EFFLUENT	STRIPPER EFFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP and AA Metals (Continued)						
Be	<5	<5	<5	<5	<5	<5
B	25800	23700	22500	23700	23000	23700
Cd	<10	<10	<10	<10	<10	<10
Ca	54100	34000	32400	32300	18700	19800
Cr	<10	<10	<10	<10	<10	<10
Co	<50	<50	<50	<50	<50	<50
Cu	883	197	<25	78	35	79
Fe	1300	816	615	535	323	408
Pb	<100	<100	<100	104	126	<100
Mg	54400	49800	49600	49500	43800	45300
Mn	294	237	227	230	189	192
Hg	<0.4	<0.4	<0.4	<0.4	<0.2	<0.2
Mo	139	118	126	135	123	135
Ni	40	<40	47	43	<40	<40
Se	<10	45	90	<10	57	<10
Ag	<1	<1	<1	<1	<1	<1
Na	2250000	2390000	2560000	2640000	2650000	2580000
Tl	<100	<100	<100	<100	<100	<100
Sn	<100	<100	<100	<100	<100	<100
Ti	<50	<50	<50	<50	<50	<50
V	<50	<50	<50	<50	<50	<50
Y	<50	<50	<50	<50	<50	<50
Zn	292	56	50	49	27	36

TABLE A-21 (Continued)

METALS RESULTS
FOR
FACILITY C - WATER SAMPLES

ICP Screening Metals	SAMPLE DAY 2					
	INFLUENT	DAF EFFLUENT	FILTER EFFLUENT	STRIPPER EFFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
Al	DET	DET	DET	DET	DET	DET
Sb	ND	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND	ND
Ba	DET	ND	ND	ND	ND	DET
Be	ND	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND	ND
B	DET	DET	DET	DET	DET	DET
Cd	ND	ND	ND	ND	ND	ND
Ca	DET	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND
Cu	DET	DET	DET	DET	DET	ND
Dy	ND	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND	ND
I	ND	ND	ND	ND	ND	ND
Ir	ND	ND	ND	ND	ND	ND
Fe	DET	DET	DET	DET	DET	DET
La	ND	ND	ND	ND	ND	ND
Li	DET	DET	DET	DET	DET	DET
Lu	ND	ND	ND	ND	ND	ND
Pb	ND	ND	ND	ND	ND	ND
Mg	DET	DET	DET	DET	DET	DET
Mn	DET	DET	DET	DET	DET	DET
Hg	ND	ND	ND	ND	ND	ND
Mo	DET	DET	DET	DET	DET	DET
Nd	ND	ND	ND	ND	ND	ND
Ni	DET	ND	DET	ND	ND	ND
Nb	ND	ND	ND	ND	ND	ND
Os	DET	DET	ND	ND	DET	ND
Pd	ND	ND	ND	ND	ND	ND

TABLE A-21 (Continued)

METALS RESULTS
FOR
FACILITY C - WATER SAMPLES

	SAMPLE DAY 2					
	INFLUENT	DAF EFFLUENT	FILTER EFFLUENT	STRIPPER EFFLUENT	FINAL EFFLUENT	DUPLICATE EFFLUENT
ICP Screening Metals (Continued)						
P	DET	DET	DET	DET	DET	DET
Pt	ND	ND	ND	ND	ND	ND
K	DET	DET	DET	DET	DET	DET
Pr	ND	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND	ND
Se	ND	DET	ND	DET	DET	DET
Si	DET	DET	DET	DET	DET	DET
Ag	ND	ND	ND	ND	ND	ND
Na	DET	DET	DET	DET	DET	DET
Sr	DET	DET	DET	DET	DET	DET
S	DET	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND	ND
Th	DET	DET	DET	ND	ND	ND
Tm	ND	ND	ND	ND	ND	ND
Sn	ND	ND	ND	ND	ND	ND
Ti	ND	ND	ND	ND	ND	ND
W	ND	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND	ND
V	ND	ND	ND	ND	ND	ND
Yb	ND	ND	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND	ND
Zn	DET	DET	DET	DET	DET	DET
Zr	ND	ND	ND	ND	ND	ND
ICP and AA Metals						
Al	639	15300	21300	10700	7260	7460
Sb	<20	<20	<20	<20	<20	<200
As	<20	<20	<20	<20	<20	<20
Ba	250	<100	<100	<100	<100	281

TABLE A-21 (Continued)

METALS RESULTS
FOR
FACILITY C - WATER SAMPLES

SAMPLE DAY 2

		DAF	FILTER	STRIPPER	FINAL	DUPLICATE
	INFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT
ICP and AA Metals (Continued)						
Be	<5	<5	<5	<5	<5	<5
B	28100	28000	27700	26700	23700	25000
Cd	<10	<10	<10	<10	<10	<10
Ca	43600	27900	29900	26600	15500	15400
Cr	<10	<10	<10	<10	<10	<10
Co	<50	<50	<50	<50	<50	<50
Cu	155	83	53	40	32	<25
Fe	1340	749	1110	570	419	428
Pb	<100	<100	<100	<100	<100	<100
Mg	65400	60800	63400	58700	48000	47700
Mn	284	250	268	264	268	270
Hg	<0.4	<0.4	<0.4	<0.4	<0.2	<0.2
Mo	174	152	146	123	157	170
Ni	69	<40	48	<40	<40	<40
Se	<10	143	<10	59	325	358
Ag	<2	<2	<1	<2	<2	<2
Na	3300000	3580000	3700000	3720000	3740000	3760000
Tl	<100	<100	<100	<100	<100	<200
Sn	<100	<100	<100	<100	<100	<100
Ti	<50	<50	<50	<50	<50	<50
V	<50	<50	<50	<50	<50	<50
Y	<50	<50	<50	<50	<50	<50
Zn	143	85	63	34	25	27

TABLE A-22

METALS RESULTS
FOR
FACILITY D - WATER SAMPLES

	SAMPLE DAY 1	
	FINAL EFFLUENT	SCRUBBER EFFLUENT
ICP Screening Metals		
Al	DET	DET
Sb	ND	ND
As	ND	ND
Ba	ND	ND
Be	ND	ND
Bi	ND	ND
B	DET	DET
Cd	DET	ND
Ca	ND	DET
Ce	ND	ND
Cr	DET	DET
Co	ND	ND
Cu	ND	ND
Dy	ND	DET
Er	ND	ND
Eu	ND	ND
Ga	ND	ND
Ge	ND	ND
Au	ND	ND
Hf	ND	ND
Ho	ND	ND
In	ND	ND
I	ND	ND
Ir	ND	ND
Fe	DET	DET
La	ND	ND
Li	ND	ND
Lu	ND	ND
Pb	ND	DET
Mg	ND	DET
Mn	DET	DET
Hg	ND	ND
Mo	ND	ND
Nd	ND	ND
Ni	ND	ND
Nb	ND	ND
Os	DET	ND
Pd	ND	ND

TABLE A-22 (Continued)

METALS RESULTS
FOR
FACILITY D - WATER SAMPLES

	SAMPLE DAY 1	
	FINAL EFFLUENT	SCRUBBER EFFLUENT
ICP Screening Metals (Continued)		
P	DET	DET
Pt	ND	ND
K	ND	ND
Pr	ND	ND
Re	ND	ND
Rh	ND	ND
Ru	ND	ND
Sm	ND	ND
Sc	ND	ND
Se	ND	ND
Si	DET	DET
Ag	ND	ND
Na	DET	DET
Sr	ND	DET
S	DET	DET
Ta	ND	ND
Te	ND	ND
Tb	ND	ND
Tl	ND	ND
Th	ND	ND
Tm	ND	ND
Sn	ND	ND
Ti	ND	ND
W	ND	ND
U	ND	ND
V	ND	ND
Yb	ND	ND
Y	ND	ND
Zn	DET	DET
Zr	ND	ND
ICP and AA Metals		
Al	<200	208
Sb	<60	<60
As	<10	<10
Ba	<100	<100

TABLE A-22 (Continued)

METALS RESULTS
FOR
FACILITY D - WATER SAMPLES

	SAMPLE DAY 1	
	FINAL EFFLUENT	SCRUBBER EFFLUENT
ICP and AA Metals (Continued)		
Be	<5	<5
B	30000	684
Cd	9	<5
Ca	<5000	27600
Cr	13	53
Co	<50	<50
Cu	<25	<25
Fe	16400	1520
Pb	<200	332
Mg	<5000	8470
Mn	318	33
Hg	<1.0	<1.0
Mo	<100	<100
Ni	<21	<40
Se	<25	<25
Ag	<10	<10
Na	542000	1020000
Tl	<100	<50
Sn	<40	<40
Ti	<50	<50
V	<50	<50
Y	<50	<50
Zn	248000	240

TABLE A-23

METALS RESULTS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
ICP Screening Metals					
Al	DET	DET	DET	DET	DET
Sb	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND
Ba	DET	DET	DET	DET	DET
Be	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND
B	DET	DET	DET	DET	DET
Cd	DET	DET	DET	DET	DET
Ca	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	ND
Cr	DET	DET	DET	DET	DET
Co	DET	DET	ND	ND	ND
Cu	DET	DET	DET	ND	ND
Dy	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND
I	ND	ND	ND	ND	ND
Ir	ND	ND	ND	ND	ND
Fe	DET	DET	DET	DET	DET
La	ND	ND	ND	ND	ND
Li	ND	ND	ND	ND	ND
Lu	ND	ND	ND	ND	ND
Pb	DET	DET	DET	ND	DET
Mg	DET	DET	DET	DET	DET
Mn	DET	DET	DET	DET	DET
Hg	DET	DET	DET	DET	ND
Mo	DET	DET	ND	ND	ND
Nd	ND	ND	ND	ND	ND
Ni	DET	DET	ND	ND	ND
Nb	ND	ND	ND	ND	ND
Os	ND	ND	ND	ND	ND
Pd	ND	ND	ND	ND	ND
P	DET	DET	DET	ND	DET

TABLE A-23 (Continued)

METALS RESULTS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
ICP Screening Metals (Continued)					
Pt	ND	ND	ND	ND	ND
K	ND	ND	ND	ND	DET
Pr	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND
Si	DET	DET	DET	DET	DET
Ag	DET	DET	ND	ND	ND
Na	DET	DET	DET	DET	DET
Sr	ND	ND	DET	DET	DET
S	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND
Th	ND	ND	ND	ND	ND
Tm	ND	ND	ND	ND	ND
Sn	DET	DET	ND	ND	DET
Ti	DET	DET	DET	ND	DET
W	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND
V	ND	ND	DET	ND	DET
Yb	ND	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND
Zn	DET	DET	DET	ND	DET
Zr	ND	ND	ND	ND	ND
ICP and AA Metals					
Al	1270	937	121000	1670	151000
Sb	<16	<2.0	<22	<1.2	<20
As	<8.0	<6.0	<22	<1.2	<20
Ba	326	398	225	62.1	254
Be	<0.6	<0.6	<4	<0.3	<6

TABLE A-23 (Continued)

METALS RESULTS
FOR
DAF SLUDGE SAMPLES

ICP and AA Metals (Continued)

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
B	246	311	1490	43.2	1590
Cd	10	8	42	0.8	49
Ca	19700	14900	24200	384	23500
Cr	2060	1560	225	3.2	216
Co	20	15	<36	<3.2	<57
Cu	211	162	881	<1.6	<28
Fe	15100	11400	5080	38.0	3320
Pb	297	1790	116	<6.4	333
Mg	2280	1760	13500	250	5220
Mn	162	1030	78.3	1.2	48.8
Hg	2	1	2.12	0.32	<1.2
Mo	72	48	<72	<6.4	<114
Ni	24	152	<29	<2.6	<45
Se	<2.0	<2.0	<11	<0.6	<10
Ag	3	2	<1.1	<0.06	<1.0
Na	576	1180	82100	6110	66400
Tl	<2.0	<2.0	<11	<0.6	<10
Sn	<13	16	<72	<6.4	253
Ti	11	63	116	<3.2	128
V	<6	<4	93.9	<3.2	98.7
Y	<6	<4	<36	<3.2	<57
Zn	1900	1440	157	<1.3	81

TABLE A-24

METALS RESULTS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
ICP Screening Metals					
Al	DET	DET	DET	DET	DET
Sb	ND	ND	ND	ND	ND
As	ND	ND	ND	ND	ND
Ba	DET	DET	DET	DET	ND
Be	DET	DET	DET	ND	ND
Bi	ND	ND	ND	ND	ND
B	DET	DET	DET	ND	ND
Cd	DET	DET	DET	DET	DET
Ca	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	DET
Cr	DET	DET	DET	DET	ND
Co	DET	DET	DET	ND	ND
Cu	DET	DET	DET	DET	DET
Dy	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND
I	DET	DET	ND	ND	ND
Ir	ND	ND	ND	ND	ND
Fe	DET	DET	DET	DET	DET
La	ND	ND	ND	ND	ND
Li	ND	ND	ND	ND	ND
Lu	ND	ND	ND	ND	ND
Pb	DET	DET	DET	DET	DET
Mg	DET	DET	DET	DET	DET
Mn	DET	DET	DET	DET	DET
Hg	ND	ND	ND	ND	DET
Mo	ND	ND	ND	ND	ND
Nd	ND	ND	ND	ND	ND
Ni	DET	DET	DET	DET	DET
Nb	ND	ND	ND	ND	ND
Os	ND	ND	ND	ND	ND
Pd	ND	ND	ND	ND	ND
P	DET	DET	DET	DET	DET

TABLE A-24 (Continued)

METALS RESULTS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
ICP Screening Metals (Continued)					
Pt	ND	ND	ND	ND	ND
K	DET	ND	DET	ND	ND
Pr	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND
Si	DET	DET	DET	DET	DET
Ag	ND	ND	ND	ND	ND
Na	DET	DET	DET	DET	DET
Sr	ND	ND	ND	DET	DET
S	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND
Th	DET	DET	DET	ND	ND
Tm	ND	ND	ND	ND	ND
Sn	DET	ND	DET	DET	DET
Ti	DET	DET	DET	DET	DET
W	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND
V	DET	DET	DET	ND	ND
Yb	ND	ND	ND	ND	ND
Y	DET	DET	DET	DET	DET
Zn	DET	DET	DET	DET	DET
Zr	ND	ND	ND	ND	ND
ICP and AA Metals					
Al	11900	12800	13400	1730	1610
Sb	<9.0	<50	<1.0	<39	<5.0
As	<9.0	<10	<9.0	<8.0	<9.0
Ba	778	775	794	432	<4
Be	18	17	18	<0.6	<0.6
B	150	138	149	<5	<4

TABLE A-24 (Continued)

METALS RESULTS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
ICP and AA Metals (Continued)					
Cd	92	85	89	2	1
Ca	10700	11800	12900	6800	5570
Cr	746	38	693	3	<2
Co	3	3	3	<3	<2
Cu	5	6	5	35	7
Fe	6620	7000	7150	1870	1450
Pb	355	26	330	25	28
Mg	12900	13500	13600	1290	19060
Mn	4420	229	4580	107	74
Hg	<0.1	<0.1	<0.1	<0.1	0
Mo	<5	<6	<6	<5	<4
Ni	138	7	137	2	2
Se	<1.0	<1.0	<1.0	<1.0	<1.0
Ag	<0.1	<0.1	<0.1	<0.1	<0.1
Na	4750	5690	4380	87	86
Tl	<1.0	<1.0	<1.0	<1.0	<1.0
Sn	5	<6	101	5	4
Ti	1900	93	1760	104	105
V	617	31	580	<3	<2
Y	15	16	17	5	5
Zn	955	71	1120	473	66

TABLE A-25

METALS RESULTS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
ICP Screening Metals			
Al	DET	DET	DET
Sb	ND	ND	ND
As	ND	ND	ND
Ba	DET	DET	DET
Be	ND	ND	ND
Bi	ND	ND	ND
B	DET	DET	DET
Cd	DET	DET	DET
Ca	DET	DET	DET
Ce	ND	ND	ND
Cr	DET	DET	DET
Co	ND	ND	DET
Cu	DET	DET	DET
Dy	ND	ND	ND
Er	ND	ND	ND
Eu	ND	ND	ND
Ga	ND	ND	ND
Ge	ND	ND	ND
Au	ND	ND	ND
Hf	ND	ND	ND
Ho	ND	ND	ND
In	ND	ND	ND
I	ND	ND	ND
Ir	ND	ND	ND
Fe	DET	DET	DET
La	ND	ND	ND
Li	ND	ND	ND
Lu	ND	ND	ND
Pb	ND	DET	ND
Mg	DET	DET	DET
Mn	DET	DET	DET
Hg	ND	ND	ND
Mo	ND	ND	ND
Nd	ND	ND	ND
Ni	DET	ND	DET
Nb	ND	ND	ND
Os	ND	ND	ND
Pd	ND	ND	ND
P	DET	DET	DET

TABLE A-25 (Continued)

METALS RESULTS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
ICP Screening Metals (Continued)			
Pt	ND	ND	ND
K	DET	DET	DET
Pr	ND	ND	ND
Re	ND	ND	ND
Rh	ND	ND	ND
Ru	ND	ND	ND
Sm	ND	ND	ND
Sc	ND	ND	ND
Se	ND	ND	ND
Si	DET	DET	DET
Ag	ND	ND	DET
Na	DET	DET	DET
Sr	DET	DET	DET
S	DET	DET	DET
Ta	ND	ND	ND
Te	ND	ND	ND
Tb	ND	ND	ND
Tl	ND	ND	ND
Th	ND	ND	ND
Tm	ND	ND	ND
Sn	ND	ND	DET
Ti	ND	DET	DET
W	ND	ND	ND
U	ND	ND	ND
V	DET	ND	DET
Yb	ND	ND	ND
Y	ND	ND	ND
Zn	DET	DET	DET
Zr	ND	ND	ND
ICP and AA Metals			
Al	1700	1070	1590
Sb	<0.7	<1.0	<1.1
As	<0.7	<1.0	<1.1
Ba	14.0	7.63	8.69

TABLE A-25 (Continued)

METALS RESULTS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
ICP and AA Metals (Continued)			
Be	<0.2	<0.3	<0.2
B	27.9	31.5	42.1
Cd	1.1	0.7	0.9
Ca	1660	1660	1880
Cr	3.2	3.4	3.5
Co	<2.4	<2.6	2.1
Cu	14.8	15.9	16.6
Fe	1620	821	1040
Pb	<4.8	6.89	<4.3
Mg	863	1200	1330
Mn	19.2	17.8	20.8
Hg	<0.06	<0.06	<0.06
Mo	<4.8	<5.3	<4.3
Ni	2.4	<2.1	1.9
Se	<0.4	<0.5	<0.6
Ag	<0.04	<0.05	<0.06
Na	4610	3790	3940
Tl	<0.4	<0.5	<0.6
Sn	<4.8	<5.3	6.49
Ti	71.6	42.2	35.3
V	3.3	<2.6	2.7
Y	<2.4	<2.7	<2.2
Zn	4.3	4.6	3.9

TABLE A-26

METALS RESULTS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
ICP Screening Metals							
Al	DET	DET	DET	DET	DET	DET	DET
Sb	ND	ND	ND	DET	ND	ND	ND
As	ND	DET	ND	ND	ND	ND	ND
Ba	ND	DET	ND	DET	DET	DET	DET
Be	ND	ND	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND	ND	ND
B	DET	DET	ND	DET	DET	DET	DET
Cd	ND	DET	ND	DET	DET	DET	DET
Ca	DET	DET	DET	DET	DET	DET	DET
Ce	ND	ND	ND	ND	ND	ND	ND
Cr	ND	DET	ND	DET	DET	DET	DET
Co	ND	ND	ND	ND	ND	ND	ND
Cu	DET	DET	DET	DET	DET	DET	DET
Dy	ND	ND	ND	ND	ND	ND	ND
Er	ND	ND	ND	ND	ND	ND	ND
Eu	ND	ND	ND	ND	ND	ND	ND
Ga	ND	ND	ND	ND	ND	ND	ND
Ge	ND	ND	ND	ND	ND	ND	ND
Au	ND	ND	ND	ND	ND	ND	ND
Hf	ND	ND	ND	ND	ND	ND	ND
Ho	ND	ND	ND	ND	ND	ND	ND
In	ND	ND	ND	ND	ND	ND	ND
I	ND	ND	ND	ND	ND	DET	DET
Ir	ND	ND	ND	ND	ND	DET	ND
Fe	DET	DET	DET	DET	DET	DET	DET
La	ND	ND	ND	ND	ND	ND	ND
Li	ND	ND	ND	ND	ND	ND	ND
Lu	ND	ND	ND	ND	ND	ND	ND
Pb	DET	DET	DET	DET	DET	DET	DET
Mg	DET	DET	DET	DET	DET	DET	DET

TABLE A-26 (Continued)

METALS RESULTS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
ICP Screening Metals (Continued)							
Mn	DET	DET	DET	DET	DET	DET	DET
Hg	ND	ND	ND	ND	ND	ND	ND
Mo	DET	DET	ND	DET	DET	DET	DET
Nd	ND	ND	ND	ND	ND	ND	ND
Ni	ND	DET	ND	ND	DET	DET	DET
Nb	ND	ND	ND	ND	ND	ND	ND
Os	ND	ND	ND	ND	ND	ND	ND
Pd	ND	ND	ND	ND	ND	ND	ND
P	DET	DET	DET	DET	DET	DET	DET
Pt	ND	ND	ND	ND	ND	ND	ND
K	ND	ND	ND	ND	ND	ND	ND
Pr	ND	ND	ND	ND	ND	ND	ND
Re	ND	ND	ND	ND	ND	ND	ND
Rh	ND	ND	ND	ND	ND	ND	ND
Ru	ND	ND	ND	ND	ND	ND	ND
Sm	ND	ND	ND	ND	ND	ND	ND
Sc	ND	ND	ND	ND	ND	ND	ND
Se	ND	ND	ND	ND	ND	ND	ND
Si	ND	ND	ND	DET	DET	DET	DET
Ag	ND	DET	DET	DET	DET	ND	ND
Na	DET	DET	DET	DET	DET	DET	DET
Sr	ND	ND	ND	ND	DET	DET	DET
S	DET	DET	DET	DET	DET	DET	DET
Ta	ND	ND	ND	ND	ND	ND	ND
Te	ND	ND	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND
Tl	ND	ND	ND	ND	ND	ND	ND
Th	ND	ND	ND	ND	ND	ND	ND
Tm	ND	ND	ND	ND	ND	ND	ND
Sn	ND	DET	ND	DET	DET	DET	DET

TABLE A-26 (Continued)

METALS RESULTS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
ICP Screening Metals (Continued)							
Ti	ND	ND	ND	ND	DET	ND	ND
W	ND	ND	ND	ND	ND	ND	ND
U	ND	ND	ND	ND	ND	ND	ND
V	ND	ND	ND	ND	DET	ND	ND
Yb	ND	ND	ND	ND	ND	ND	ND
Y	ND	ND	ND	ND	ND	ND	ND
Zn	DET	DET	DET	DET	DET	DET	DET
Zr	ND	ND	ND	ND	ND	ND	ND
ICP and AA Metals							
Al	15	65	15	71.8	191	72	67
Sb	<8.0	<1.0	<2.0	3.1	<2.6	<5	<5
As	<1.0	1	<2.0	<1.0	<0.9	<1.0	<1
Ba	<5	453	<5	90.2	228	97	101
Be	<0.6	<0.6	<0.6	<0.2	<0.2	<1	<1
B	232	412	<5	9.40	9.11	37	27
Cd	<1	1	<0.5	3.4	4.9	4.6	4.8
Ca	2770	24100	3344	1080	1350	3460	3440
Cr	<3	3	<3	10.9	26	17	18
Co	<3	<2	<3	<2.1	<2.2	<3.0	<4.0
Cu	6	27	4	1.0	100	203	202
Fe	277	267	54	293	430	775	794
Pb	919	126	456	354	366	957	973
Mg	629	5765	811	473	572	1530	1550
Mn	21	9	34	13.2	14.3	32	32
Hg	<0.1	<0.1	<0.1	<0.04	<0.04	<0.1	<0.1
Mo	6	5	<5	10.8	13.0	25	27
Ni	<2	1	<2	<1.7	6.41	7.4	7.0

TABLE A-26 (Continued)

METALS RESULTS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
ICP and AA Metals (Continued)							
Se	<1.0	<1.0	<2.0	<0.5	<0.5	<2	<1
Ag	<0.1	0	0	0.33	0.26	<0.6	<0.4
Na	175	353	103	608	803	996	1080
Tl	<1.0	<1.0	<2.0	<0.5	<0.5	<1	<1
Sn	<5	4	<5	7.43	10.2	16	23
Ti	<3	<2	<3	<2.1	3.6	<3.0	<5.0
V	<3	<2	<3	<2.1	4.92	<3.0	<5.0
Y	<3	<2	<3	<2.1	<2.2	<3.0	<5
Zn	1840	311	1540	984	1040	3660	3800

TABLE A-27

METALS RESULTS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
ICP Screening Metals				
Al	DET	DET	DET	DET
Sb	ND	ND	ND	ND
As	ND	ND	ND	ND
Ba	DET	DET	DET	DET
Be	ND	ND	ND	ND
Bi	ND	ND	ND	ND
B	DET	DET	DET	DET
Cd	DET	DET	DET	DET
Ca	DET	DET	DET	DET
Ce	ND	ND	ND	ND
Cr	DET	DET	DET	ND
Co	DET	DET	DET	DET
Cu	DET	DET	DET	DET
Dy	ND	ND	ND	ND
Er	ND	ND	ND	ND
Eu	ND	ND	ND	ND
Ga	ND	ND	ND	ND
Ge	ND	ND	ND	ND
Au	ND	ND	ND	ND
Hf	ND	ND	ND	ND
Ho	ND	ND	ND	ND
In	ND	ND	ND	ND
I	ND	ND	ND	ND
Ir	DET	DET	DET	DET
Fe	DET	DET	DET	DET
La	ND	ND	ND	ND
Li	ND	ND	ND	ND
Lu	ND	ND	ND	ND
Pb	DET	DET	DET	DET
Mg	DET	DET	DET	DET
Mn	DET	DET	ND	ND
Hg	ND	DET	ND	ND
Mo	DET	DET	DET	DET
Nd	ND	ND	ND	ND
Ni	DET	ND	ND	ND
Nb	ND	ND	ND	ND
Os	ND	ND	ND	ND
Pd	ND	ND	ND	ND
P	DET	DET	DET	DET
Pt	ND	ND	ND	ND

TABLE A-27 (Continued)

METALS RESULTS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
ICP Screening Metals (Continued)				
K	ND	ND	ND	ND
Pr	ND	ND	ND	ND
Re	ND	ND	ND	ND
Rh	ND	ND	ND	ND
Ru	ND	ND	ND	ND
Sm	ND	ND	ND	ND
Sc	ND	ND	ND	ND
Se	ND	ND	ND	ND
Si	DET	DET	DET	DET
Ag	ND	DET	DET	DET
Na	DET	DET	DET	DET
Sr	ND	ND	ND	ND
S	DET	DET	DET	DET
Ta	ND	ND	ND	ND
Te	ND	ND	ND	ND
Tb	ND	ND	ND	ND
Tl	ND	ND	ND	ND
Th	ND	ND	ND	DET
Tm	ND	ND	ND	ND
Sn	DET	DET	DET	DET
Ti	DET	DET	DET	DET
W	ND	ND	ND	ND
U	DET	DET	DET	DET
V	DET	DET	DET	DET
Yb	ND	ND	ND	ND
Y	ND	ND	ND	ND
Zn	DET	DET	DET	DET
Zr	ND	ND	ND	ND
ICP and AA Metals				
Al	1700	1800	1410	1790
Sb	<245	<260	<164	<170
As	<13	<13	<9.0	<17
Ba	20	85	115	123
Be	<0.6	<0.6	<0.6	<0.6
B	1570	1450	920	1940
Cd	57	56	79	155
Ca	27600	23900	6540	11600

TABLE A-27 (Continued)

METALS RESULTS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
ICP and AA Metals (Continued)				
Cr	6	8	2	<5
Co	119	26	31	63
Cu	220	226	271	553
Fe	76300	81500	80900	177000
Pb	294	106	68	125
Mg	3330	2520	1690	2830
Mn	82	9	<2	<2
Hg	<0.1	0	<0.1	<0.1
Mo	83	70	59	121
Ni	54	<5	<4	<4
Se	<3.0	<3.0	<2.0	<2.0
Ag	<0.3	1	1	2
Na	2420	2960	2740	1540
Tl	<3.0	<3.0	<2.0	<2.0
Sn	72	19	14	21
Ti	176	45	42	61
V	50	12	16	19
Y	<6	<6	<5	<5
Zn	1620	2440	641	1320

TABLE A-28

RCRA CHARACTERISTICS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
Ignitability (Degrees F)	>200	>200	>200	>200	>120
Corrosivity (as pH or mmpy)	0.31 mmpy	0.26 mmpy	8.51 (as pH)	2.10 mmpy	7.94 (as pH)
Reactivity	(CN-/S+)	(CN-/S+)	(CN-/S+)	(CN+/S-)	(CN-/S+)
PCB's (mg/kg)	<3	<2	<30	<2	<30
TCLP ORGANICS (ug/l)					
Volatiles					
ACROLEIN	1940	1265	515		
BENZENE	409	426	537		
1,2-DICHLOROETHANE		229	157	307	
1,1,1-TRICHLOROETHANE	1015	957	2561	834	1919
1,1-DICHLOROETHANE	1397	1465	308	152	
1,1,2-TRICHLOROETHANE		44	15	11	
1,1,2,2-TETRACHLOROETHANE				136	
CHLOROETHANE			784		
CHLOROFORM			12		
1,1-DICHLOROETHENE			14		
ETHYLBENZENE	370	321	222	28	
TETRACHLOROETHENE	340	389	236	18	
TOLUENE	1885	1752	1727	329	1998
TRICHLOROETHENE	418	391	18		
2-BUTANONE (MEK)			2654	2931	
CARBON DISULFIDE		52	54		
IODOMETHANE		116			

TABLE A-28 (Continued)

RCRA CHARACTERISTICS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
Volatiles (Continued)					

4-METHYL-2-PENTANONE	948	1198	283	1127	346
TRICHLOROFLUOROMETHANE		25	45		
Semi-Volatiles					

4-CHLORO-3-METHYLPHENOL			93	150	136
1,2-DICHLOROBENZENE					30
1,4-DICHLOROBENZENE					11
2,4-DIMETHYLPHENOL		1384	640	668	624
ISOPHORONE			32		
NAPHTHALENE	1945	3137	253	109	291
4-NITROPHENOL				83	
2-METHYL-4,6-DINITROPHENOL				28	
PHENOL	14293	21047	8107	19007	8805
ALPHA-PICOLINE				69	
N-DODECANE (N-C12)	7054	12144	2323		2800
DIPHENYL ETHER			36		39
BIPHENYL			23	246	
N-DECANE (N-C10)		3329	300		1298
N-TETRADECANE (N-C14)	13143	7468	53		
N-HEXADECANE (N-C16)	9922	12386			
N-OCTADECANE (N-C18)	4671	5847			
N-EICOSANE (N-C20)	6020	7298			
N-DOCOSANE (N-C22)	1216				
ACETOPHENONE			16		
O-CRESOL		1307	933	3081	1295
2-METHYLNAPHTHALENE		6038	1126	39	186
1-METHYLPHENANTHRENE		2252			
PYRIDINE			82		94

TABLE A-28 (Continued)

RCRA CHARACTERISTICS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
Semi-Volatiles (Continued)					
O-TOLUIDINE			22		
BENZOIC ACID			6178	5878	6733
P-CRESOL		1092	2486	7537	2797
HEXANOIC ACID			5109	17657	4567
TCLP METALS (ug/l)					
Al-TCLP	210	<200	366000	245000	197000
Sb-TCLP	<100	<20	<20	<20	<20
As-TCLP	<20	<20	<200	<20	<20
Ba-TCLP	162	<100	1920	1160	1820
Be-TCLP	<5	<5	<5	<5	<5
B-TCLP	1080	868	8440	12700	5110
Cd-TCLP	18	21	61	53	44
Ca-TCLP	275000	297000	115000	82300	58700
Cr-TCLP	787	427	365	304	257
Co-TCLP	<50	<50	<50	<50	<50
Cu-TCLP	<25	<25	<25	<25	<25
Fe-TCLP	42600	53900	13100	6470	6520
Pb-TCLP	<200	<200	<100	<100	<100
Mg-TCLP	28700	30200	47700	52500	11600
Mn-TCLP	2210	2340	335	288	127
Hg-TCLP	<0.2	<0.2	<0.4	<0.2	<0.4
Mo-TCLP	<100	<100	155	161	124
Ni-TCLP	<40	42	83	67	51
Se-TCLP	<20	<20	<10	<10	<10
Ag-TCLP	<20	<20	<1	<1	<1

TABLE A-28 (Continued)

RCRA CHARACTERISTICS
FOR
DAF SLUDGE SAMPLES

	FACILITY B		FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
TCLP METALS (ug/l) (Continued)					

Na-TCLP	1270000	1330000	2110000	2460000	1660000
Tl-TCLP	<20	<20	<20	<20	<20
Sn-TCLP	<100	<100	<100	100	223
Ti-TCLP	<50	<50	247	178	161
V-TCLP	<50	<50	214	201	140
Y-TCLP	<50	<50	<50	<50	<50
Zn-TCLP	186	107	1030	461	1060
DIOXINS					

1,2,3,4,6,7,8-HpCDD	736 ppt	832 ppt	ND	ND	ND
Total HpCDD	1598 ppt	1859 ppt	ND	ND	ND
OCDD	7886 ppt	6913 ppt	ND	ND	ND
1,2,3,6,7,8-HxCDD	ND	ND	ND	ND	ND
Total HxCDD	863 ppt	ND	ND	ND	ND
2,3,7,8-TCDF	ND	ND	ND	ND	ND
Total TCDF	ND	ND	ND	ND	ND
Total PCDD	ND	ND	ND	ND	ND

TABLE A-29

RCRA CHARACTERISTICS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
Ignitability (Degrees F)	>200	>200	>200	>200	>200
Corrosivity (as pH or mmpy)	8.33 (as pH)	4.95 (as pH)	9.17 (as pH)	0.31 mmpy	0.02 mmpy
Reactivity	(CN-/S-)	(CN-/S-)	(CN-/S-)	(CN-/S-)	(CN-/S-)
PCB's (mg/kg)	<2	<2	<2	<2	<2
TCLP ORGANICS (ug/l)					
Volatiles					
1,2-DICHLOROETHANE					51
TOLUENE			886		14
2-BUTANONE (MEK)			79		
2-HEXANONE			2560		
4-METHYL-2-PENTANONE	10		22		
Semi-Volatiles					
2-CHLOROPHENOL					20
2,4-DIMETHYLPHENOL	1185			243	284
NAPHTHALENE					10
PHENOL	1950	2323	30471	7824	5628
PHENANTHRENE	1553		2054		
N-DODECANE (N-C12)			1395		
DIPHENYL ETHER			5513		
BIPHENYL			1875		

TABLE A-29 (Continued)

RCRA CHARACTERISTICS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
Semi-Volatiles (Continued)					
N-TETRADECANE (N-C14)	2696		25777		
N-HEXADECANE (N-C16)	22502		85285		
N-OCTADECANE (N-C18)	8031		13886		
N-EICOSANE (N-C20)		6942	10777		
N-DOCOSANE (N-C22)					
N-TETRACOSANE (N-C24)		12068	47408		
N-HEXACOSANE (N-C26)		6021			
N-OCTACOSANE (N-C28)		38742			
N-TRIACONTANE (N-C30)		51252	10745		
O-CRESOL				148	90
3,6-DIMETHYLPHENANTHRENE			10239		
4,5-METHYLENEPHENANTHRENE			1114		
1-METHYLFLUORENE			3443		
1-METHYLPHENANTHRENE	8398		4005		
P-CRESOL				206	101
HEXANOIC ACID				105	23
TCLP METALS (ug/l)					
Al-TCLP	<200	<200	323	650	762
Sb-TCLP	<40	<100	<100	<120	<2000
As-TCLP	28	35	36	<20	<20
Ba-TCLP	288	339	359	353	278
Be-TCLP	<5	<5	<5	<5	<5
B-TCLP	260	330	381	372	550
Cd-TCLP	16	15	16	<10	16
Ca-TCLP	175000	185000	191000	148000	324000
Cr-TCLP	<50	<50	<50	<50	<50

TABLE A-29 (Continued)

RCRA CHARACTERISTICS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
TCLP METALS (ug/l) (Continued)					
Co-TCLP	<50	<50	<50	<50	<50
Cu-TCLP	<25	45	<25	<25	<25
Fe-TCLP	<100	<100	<100	8110	22200
Pb-TCLP	<200	<200	<200	<200	270
Mg-TCLP	49500	43900	41000	9340	26900
Mn-TCLP	1650	1920	1910	2090	3750
Hg-TCLP	<0.2	<0.2	<0.2	<0.2	<0.2
Mo-TCLP	<100	<100	<100	<100	<100
Ni-TCLP	<40	<40	<40	<40	<40
Se-TCLP	<20	<20	<20	<20	<20
Ag-TCLP	<20	<20	<20	<20	<20
Na-TCLP	1650000	1610000	1550000	1400000	1480000
Tl-TCLP	<20	<20	<20	<20	<20
Sn-TCLP	<100	<100	<100	<100	<100
Ti-TCLP	<50	<50	<50	<50	<50
V-TCLP	<50	<50	<50	<50	<50
Y-TCLP	<50	<50	<50	<50	62
Zn-TCLP	191	263	249	1010	1890
DIOXINS					
1,2,3,4,6,7,8-HpCDD	ND	ND	ND	ND	2145 ppt
Total HpCDD	ND	ND	ND	ND	9054 ppt
OCDD	ND	ND	390 ppt	7415 ppt	11496 ppt

TABLE A-29 (Continued)

RCRA CHARACTERISTICS
FOR
SPENT CLAY SAMPLES

	FACILITY A			FACILITY B	
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	SAMPLE DAY 1	SAMPLE DAY 2
DIOXINS (Continued)					

1,2,3,6,7,8-HxCDD	ND	ND	ND	ND	ND
Total HxCDD	ND	ND	ND	ND	3230 ppt
2,3,7,8-TCDF	ND	ND	ND	ND	ND
Total TCDF	ND	ND	ND	ND	ND
Total PCDD	ND	ND	ND	ND	ND

TABLE A-30

RCRA CHARACTERISTICS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
Ignitability (Degrees F)	>200	>200	>200
Corrosivity (as pH or mmpy)	2.60 mmpy	1.10 mmpy	1.30 mmpy
Reactivity	(CN-/S-)	(CN-/S-)	(CN-/S-)
PCB's (mg/kg)	<2	<2	<2
TCLP ORGANICS (ug/l)			
Volatiles			
ACROLEIN	1307		
BENZENE	44		
1,2-DICHLOROETHANE	110		
1,1,1-TRICHLOROETHANE	364	102	
1,1-DICHLOROETHANE	444	243	154
CHLOROFORM	16		
2-BUTANONE (MEK)	11281	13001	9383
DIETHYL ETHER		71	
4-METHYL-2-PENTANONE	601	168	86
Semi-Volatiles			
PHENOL	950	238	89
ALPHA-PICOLINE	68		
N-DODECANE (N-C12)			31
O-CRESOL	37		
PYRIDINE	256		
O-TOLUIDINE			12
BENZOIC ACID	156	17	14
P-CRESOL	145		
HEXANOIC ACID	438	475	598
TCLP METALS (ug/l)			
Al-TCLP	2050	1070	1360
Sb-TCLP	<20	<200	<20

TABLE A-30 (Continued)

RCRA CHARACTERISTICS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
TCLP METALS (ug/l) (Continued)			

As-TCLP	<40	<20	<20
Ba-TCLP	1670	3140	3520
Be-TCLP	<5	<5	<5
B-TCLP	2460	3700	4110
Cd-TCLP	<10	11	<10
Ca-TCLP	18200	44600	46900
Cr-TCLP	<50	<50	<50
Co-TCLP	<50	<50	<50
Cu-TCLP	<25	<25	<25
Fe-TCLP	372	<100	268
Pb-TCLP	<100	<100	<100
Mg-TCLP	7710	25700	26600
Mn-TCLP	160	141	176
Hg-TCLP	<0.2	<0.4	<0.4
Mo-TCLP	<100	<100	<100
Ni-TCLP	104	<40	<40
Se-TCLP	<10	<10	<10
Ag-TCLP	<1	<1	<1
Na-TCLP	1670000	1660000	1550000
Tl-TCLP	<20	<20	<20
Sn-TCLP	258	<100	151
Ti-TCLP	<50	<50	<50
V-TCLP	<50	<50	<50
Y-TCLP	<50	<50	<50
Zn-TCLP	1180	2220	2550
DIOXINS			

1,2,3,4,6,7,8-HpCDD	ND	ND	ND
Total HpCDD	ND	ND	ND
OCDD	ND	ND	ND

TABLE A-30 (Continued)

RCRA CHARACTERISTICS
FOR
SPENT CARBON SAMPLES

	FACILITY C		
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3
DIOXINS (Continued)			
1,2,3,6,7,8-HxCDD	ND	ND	ND
Total HxCDD	ND	ND	ND
2,3,7,8-TCDF	3.92 ppb	ND	ND
Total TCDF	3.92 ppb	ND	ND
Total PCDD	ND	ND	ND

TABLE A-31

RCRA CHARACTERISTICS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
Ignitability (Degrees F)	>200	>200	>150	>200	>150	>200	>200
Corrosivity (as pH or mmpy)	0.05 mmpy	0.06 mmpy	0.02 mmpy	0.01 mmpy	0.30 mmpy	0.53 mmpy	0.04 mmpy
Reactivity	(CN-/S-	(CN-/S-)	(CN-/S-)	(CN-/S+)	(CN-/S-)	(CN-/S-)	(CN-/S-)
PCB's (mg/kg)	<10	<10	<10	<1	<10	<10	<10
TCLP ORGANICS (ug/l)							
Volatiles							
ACROLEIN			549				211
1,2-DICHLOROETHANE			85		854	87	13
1,1-DICHLOROETHANE					295		
1,1,2-TRICHLOROETHANE			19			115	
2-BUTANONE (MEK)		226				100	85
2-HEXANONE					57		
IODOMETHANE			25				
METHYL METHACRYLATE	24				120	127	87
Semi-Volatiles							
2,4-DIMETHYLPHENOL	24			76	76	60	57
PHENOL	75	58		1733	442	86	78
N-DECANE (N-C10)				272			
N-OCTADECANE (N-C18)					10		
N-DOCOSANE (N-C22)					11		
N-HEXACOSANE (N-C26)					56		
ANILINE				45	113		

TABLE A-31 (Continued)

RCRA CHARACTERISTICS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
Semi-Volatiles (Continued)							
BENZYL ALCOHOL							
O-CRESOL				47	51	50	27
O-TOLUIDINE				41	35	13	
BENZOIC ACID	61			265	123	73	
P-CRESOL				76	80	57	34
HEXANOIC ACID				38	32		
TCLP METALS (ug/l)							
Al-TCLP	262	1470	678	210	298	4990	255
Sb-TCLP	24	<20	<20	<20	<20	60	<20
As-TCLP	<20	<20	<20	<20	<20	<10	<10
Ba-TCLP	240	3030	1460	599	786	688	1420
Be-TCLP	<5	<5	<5	<5	<5	<5	<5
B-TCLP	1030	2380	818	444	404	659	885
Cd-TCLP	10	18	<10	<10	<10	<5	<5
Ca-TCLP	31500	39600	6560	25700	21200	71100	47200
Cr-TCLP	<50	<50	<50	<50	<50	18	<10
Co-TCLP	<50	<50	<50	<50	<50	<50	50
Cu-TCLP	<25	<25	<25	<25	<25	<25	<25
Fe-TCLP	2230	3310	1130	2470	1690	6920	44706
Pb-TCLP	<200	517	670	268	<100	306	306
Mg-TCLP	12000	9350	2230	9310	8980	31800	19600
Mn-TCLP	123	406	77	208	172	420	303
Hg-TCLP	<0.2	<0.2	<0.2	<0.4	<0.4	<0.2	<0.2
Mo-TCLP	<100	<100	<100	<100	<100	<100	<100
Ni-TCLP	<40	<40	<40	<40	<40	<40	<40
Se-TCLP	<20	<20	<20	<10	<10	<5	<5

TABLE A-31 (Continued)

RCRA CHARACTERISTICS
FOR
DISTILLATION BOTTOMS SAMPLES

	FACILITY A	FACILITY B		FACILITY C		FACILITY D	
	SAMPLE DAY 1	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 1	SAMPLE DAY 2
TCLP METALS (ug/l) (Continued)							
Ag-TCLP	<20	<20	<20	<1	<1	<10	<10
Na-TCLP	1430000	1400000	1520000	1520000	1640000	1520000	1390000
Tl-TCLP	<20	<20	<20	<20	<20	<10	<10
Sn-TCLP	<100	<100	<100	177	237	<40	<40
Ti-TCLP	<50	<50	<50	<50	<50	<50	<50
V-TCLP	<50	<50	<50	<50	<50	<50	<50
Y-TCLP	<50	<50	<50	<50	<50	<50	<50
Zn-TCLP	1590	7900	1910	3920	4040	7840	6030
DIOXINS							
1,2,3,4,6,7,8-HpCDD	ND	529 ppt	ND	883 ppt	1710 ppt	1.65 ppb	2.02 ppb
Total HpCDD	ND	1477 ppt	ND	1604 ppt	3283 ppt	1.65 ppb	2.02 ppb
OCDD	1138 ppt	1786 ppt	ND	3918 ppt	7088 ppt	11.99 ppb	9.35 ppb
1,2,3,6,7,8-HxCDD	ND	ND	ND	189 ppt	636 ppt	ND	ND
Total HxCDD	ND	ND	ND	1134 ppt	3980 ppt	ND	ND
2,3,7,8-TCDF	ND	ND	ND	ND	ND	ND	ND
Total TCDF	ND	ND	ND	ND	ND	ND	ND
Total PCDD	ND	ND	ND	ND	95 ppt	ND	ND

TABLE A-32

RCRA CHARACTERISTICS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
Ignitability (Degrees F)	>200	>200	>200	>200
Corrosivity (as pH or mmpy)	8.50 (as pH)	8.77 (as pH)	7.40 (as pH)	7.38 (as pH)
Reactivity	(CN-/S-)	(CN-/S-)	(CN-/S-)	(CN-/S-)
PCB's (mg/kg)	<3	<3	<2	<3
TCLP ORGANICS (ug/l)				
Volatiles				
1,1,1-TRICHLOROETHANE				349
ETHYLBENZENE		88		82
TOLUENE			11	549
TRICHLOROETHENE		52		
2-BUTANONE (MEK)			116	
P-DIOXANE			2987	6132
Semi-Volatiles				
4-CHLORO-3-METHYLPHENOL				264
2-CHLOROPHENOL				11
2,4-DIMETHYLPHENOL	1076	1039	1827	
NAPHTHALENE	279	347	273	305
2-NITROPHENOL	29	183	39	70
4-NITROPHENOL		186	181	300
PHENOL	22371		21687	138876
N-DODECANE (N-C12)	848		130	217
DIPHENYL ETHER	275	310	348	435
BIPHENYL	117	125	179	286
P-CYMENE				25
N-DECANE (N-C10)	1090			
N-TETRADECANE (N-C14)			317	783
N-HEXADECANE (N-C16)			233	518
N-OCTADECANE (N-C18)				19
N-HEXACOSANE (N-C26)			14	
N-OCTACOSANE (N-C28)			11	
O-CRESOL	182	365	271	207
2-METHYLNAPHTHALENE	79	107	123	142

TABLE A-32 (Continued)

RCRA CHARACTERISTICS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
Semi-Volatiles (Continued)				
BENZOIC ACID	673			
P-CRESOL	1051	1253	1559	1998
HEXANOIC ACID	201		210	185
TCLP METALS (ug/l)				
Al-TCLP	<200	429	641	524
Sb-TCLP	<200	<200	<20	<40
As-TCLP	<20	<20	<20	<20
Ba-TCLP	337	732	325	497
Be-TCLP	<5	<5	<5	<5
B-TCLP	12500	7460	1230	1870
Cd-TCLP	11	27	22	23
Ca-TCLP	590000	429000	143000	221000
Cr-TCLP	<50	<50	<50	<50
Co-TCLP	<50	153	262	406
Cu-TCLP	101	151	117	102
Fe-TCLP	<100	<100	1590	1060
Pb-TCLP	<200	<200	<200	<200
Mg-TCLP	92200	39100	2290	4150
Mn-TCLP	368	2380	880	1490
Hg-TCLP	<0.2	<0.2	<0.2	<0.2
Mo-TCLP	104	<100	<100	<100
Ni-TCLP	46	113	48	55
Se-TCLP	<20	<20	<20	<20
Ag-TCLP	<20	<20	<20	<20
Na-TCLP	1290000	1400000	1400000	1370000
Tl-TCLP	<20	<20	<20	<20
Sn-TCLP	<100	<100	<100	<100
Ti-TCLP	<50	<50	<50	<50
V-TCLP	<50	<50	<50	<50
Y-TCLP	<50	<50	<50	<50
Zn-TCLP	384	11000	5950	6750

TABLE A-32 (Continued)

RCRA CHARACTERISTICS
FOR
FILTER CAKE SAMPLES

	FACILITY A			
	SAMPLE DAY 1	SAMPLE DAY 2	SAMPLE DAY 3	
DIOXINS				
1,2,3,4,6,7,8-HpCDD	ND	ND	ND	ND
Total HpCDD	ND	ND	ND	ND
OCDD	ND	ND	ND	ND
1,2,3,6,7,8-HxCDD	ND	ND	ND	ND
Total HxCDD	ND	ND	ND	ND
2,3,7,8-TCDF	ND	ND	ND	ND
Total TCDF	ND	ND	ND	ND
Total PCDD	ND	ND	ND	ND

TABLE A-33

USED OIL CONTAMINANT CONCENTRATIONS AS COMPARED TO HEALTH BASED CRITERIA

Constituent	Concentration in Used Oil (1) (90th percentile, ppm)	AWQCL (2) (ppm)	DWS (2) (Long-Term) SNARL (ppm)	Solubility ppm
Lead	1200	.05	.05	-
Tetrachloroethylene	1300	.008	.02	150
Toluene	5000	14.3	.343	535
1,1,1-Trichloroethane	3100	18.4	1	720
Trichloroethylene	1000	.027	.075	1,000
Naphthalene	990	(3)	---	

Ratio of Concentration to Criteria

Constituent	Concentration /AWQCL	Concentration /DWS	Solubility /AWQCL	Solubility /DWS
Lead	24,000	24,000	--	--
Tetrachloroethylene	162,500	65,000	18,800	7,500
Toluene	350	14,600	37	1,560
1,1,1-Trichloroethane	170	3,100	40	720
Trichloroethylene	37,000	13,300	37,000	13,300
Naphthalene	---	---	---	---

Sources:

(1) Background Document for Used Oil

(2) U.S. EPA, 1980. Health and Environmental Effects Profile. RCRA Subtitle C Background Document appendix A. Office of Solid Waste, Washington, D.C.

(3) No health-based standard has yet been developed for naphthalene

GLOSSARY AND ABBREVIATIONS

Air Flotation	Consists of saturation of a portion of the wastewater feed, or a portion of the feed or recycled effluent from the flotation unit with air at a specific pressure.
APR	Association of Petroleum Refineries
ASTM	American Society for Testing and Materials
BAT	Best Available Technology
BETC	Bartlesville Energy Technology Center
BCT	Best Conventional Pollutant Control Technology
BMP	Best Management Practices
BOD	Biochemical Oxygen-Demanding Pollutants
BPCTCA	Best Practical Control Technology Currently Available
Color.	Colorimetric
CLP	Method modified for application to solids by the Superfund Contract Laboratory Program
Corrosiv.	Hazardous waste characteristics of corrosivity
Conventional	Conventional wastewater chemistry analytes
CVAS	Cold Vapor Absorption Spectrometry

DAF Effluent	Water effluents from DAF
DAF Sludge	Skimmed sludge from DAF sludge
Dioxin, Furans	Chlorinated dibenzo-p-dioxins and chlorinated dibenzo furans
Distillation Bottoms	Asphalt flux extender
End-of-Pipe Effluent	Final discharge to sanitary sewer system
EPA	Environmental Protection Agency
Field Test	Test performed at site
Filter Cake	Waste clay resulting from various lube oil polishing practices
Filter Effluent	Water effluents from a filtration system
Fraction	A means of further categorizing the sample for purposes of analysis
Furnace	Metals analyzed by furnace atomic absorption
GCMS	Gas Chromatography Combined with a Mass Spectrometer detection
GCES	Gas Chromatography Combined with an electron capture detector
GCFPD	Gas Chromatography Combined with a Flame Photometric Detector
Grav.	Gravimetric
HRGCHRMS	High Resolution Gas Chromatography Combined with High Resolution Mass Spectrometry
ICP Metals	Metals analyzed by inductively coupled plasma spectrometry

Ignit.	Hazardous waste characteristic of ignitability
Influent	Untreated process wastewater
Ion Chrom.	Ion Chromatography
ITD	Industrial Technology Division
Method	EPA Method Number
NIPER	National Institute for Petroleum Energy Research
NIOSH	National Institute Occupational Safety and Health
NORA	National Oil Recyclers Association
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
NTIS	National Technical Information Service
Oily Sludge	Settled solids from a process, almost any flocculated, settled mass
OSW	EPA Office of Solid Waste
Organic	A material that contains carbon compounds
POTW	Publicly Owned Treatment Works
PCB	Polychlorinated Biphenyls
PNA	Polynuclear Aromatics
RCRA	Resource Conservation and Recovery Act
React.	Hazardous waste characteristic of reactivity

SCC	Sample Control Center, an EPA contract operation for management of environmental samples.
Scrubber Effluent	Flue gas scrubber water
SIC	Standard Industrial Classification
SNARL	Suggested No Adverse Response Level
SPADNS	Distillation followed by colorimetric analysis.
Stripper Effluent	Sour water stripper effluent
Spent Carbon Wastes	Activated carbon treatment wastes
Spent Clay	Waste clay resulting from various clay contact filtration practices.
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
Titr.	Titrimetric
TSS	Total Suspended Solids
TVOC	Total Volatile Organic Compounds
VOA	Volatile Organics Analysis

LIST OF REFERENCES

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